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STUDIES ON THE ACARINA OF ILLINOIS

BY

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THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

Henry Ellsworth Ewing,

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OF Bachelor of Arts.

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INTRODUCTION.

The Acarina, or mites, have always been an interesting group to the biologist. Their peculiar habits, their economic importance, and their varied and often complex life histories afford an excellent field for investigation. Their economic importance is such as to attract the attention of many special students. Some of the Acarina are beneficial,--for example, Trombidium locustarium, the larva of which is parasitic on common grasshoppers and the adult of which lives largely on grasshopper eggs. Several species of mites are known to eat plant lice and are therefore beneficial. Yet perhaps the majority of the Acarina are injurious, directly or indirectly. Gamasidae and Ixodidae are parasitic, often on domestic animals and poultry. The cattle ticks (Ixodidae) are known to transmit certain diseases. Some mites are parasitic on bees; others live in the skin of animals and man. The itch mites have long been known as human pests. Many of the"running sores" of domestic animals are due to mites. Some mites do great damage to plants, thus some species of Trombidium destroy garden plants. Then there are the "gall mites" which inflict considerable injury upon trees as well as other plants.

Few classes of animals have as wide a distribution as mites. They have been found in all parts of the known world and in most places abundantly. Mites are found not only in all parts of the earth but live under very different conditions in the same locality.

Many mites are aquatic, many are parasitic, living on mammals, birds, fishes and insects; others are found on the leaves of trees, under rocks, boards, logs, moss, dead leaves and rubbish.

Among the earliest investigators to be attracted to the study of mites were the following: Müller, who studied the aquatic forms; Geoffroy in 1762; Latreille in about 1795; O. Fabricus at about the same time; Hermann in 1804; Heyden in 1816; Dugès in 1834. Yet until the time of C. L. Koch, or about 1840, this great field of study was but little explored. In his "Deutschlands Crustaceen, Miriopoden und Arachniden" (1835-'40) Koch describes and figures several hundred species. He thoroughly investigated the mites of Germany and his work forms the basis of much of our present classification. Several years later, A. Murray, the first English authority to investigate the field, devoted nearly 300 pages in his "Aptera" to the subject of mites. This book was for many years regarded as authoritive by English students. Of recent years there have been several distinguished European investigators of Acarina. A. D. Michael, in his two volumes on "British Oribatidae", has covered that family very thoroughly. In "Das Tierreich", Lief. 3, 1898, Michael gives a key for the identification of species of Oribatidae. In France, Nicolet in his " Acariens des Environs de Paris," describes and accurately figures many species. In Italy, A. Berlese and G. Conestrini have done excellent, comprehensive work on mites. In Norway, Thor has described many species, especially of the family Bdellidae. I. Trägårdh has done much work on mites collected from Greenland, Spitzbergen, Siberia, Egypt, Soudan and other parts of the world. In America the only investigator who

has given much attention to mites is Nathan Banks. A few of the other well known students of Acarina are: G. Leonardi, F. Fanzago, P. Kramer, E. Claparède, L. Karpelles, M. P. Megnin , E. Perrier and F. Karsch.

The Acarina form an order under the class Arachnida. Some authorities have endeavored to make a separate class of Acarina, but most authorities, however, do not believe that there are sufficient grounds for their separation as a class. The mites are related to the spiders in more ways than one: they have four pairs of legs, almost without exception, in the adult form; they have no distinct head and no antennae. Mites not only have a superficial resemblance to spiders but their habits and food in some cases are nearly identical with those of spiders. The Tetranychinae, which affect plants, are popularly known as "red spiders." Many mites live on the eggs and larvae of insects, and even upon other mites.

METHODS.

Collecting. In making my collections several methods were used, depending upon the number of specimens desired and also upon the habits of the mites. For most purposes I used vials and camel's hair brushes. By moistening the point of a brush and then applying it to a mite, the latter could be transferred to a vial. This method succeeds with mites which have a hard or leathery integument but is often disastrous to small and soft species. In collecting the latter, one should not moisten the brush, since it adheres to the specimens so strongly that the latter cannot be detached without distortion. When mites were found on leaves, moss, etc., these materials were taken to the laboratory for inspection with a hand lens. Mites were often collected by jarring plants or other material over a wide mouthed bottle.

When large quantities of specimens were desired, two methods were used. The first of these is a method devised by A. Berlese, who employed an apparatus described in the "Entomological News" Vol. 27, No. 2, Feb. 1906, pp. 49-54. Following the directions given by Berlese, we made a galvanized sheet iron boiler, cylindrical in shape and about two and a half feet long by fourteen inches in diameter. Inside this cylinder and extending its full length, was a large funnel, about one foot in diameter at the top and tapering to about three fourths of an inch in diameter at the bottom. The mouth of the funnel passed through the base of the boiler. In operation, the boiler was filled with

water which was kept at a temperature of about 80° C. by means of a gas burner. The boiler was supported in an upright position by a tripod. Now a pan with a perforated bottom was placed over the top of the funnel and a bottle containing a little water was placed under the mouth of the funnel. The apparatus being ready, the material containing mites, and other small organisms was placed in the perforated pan. The mites upon feeling the warmth would go down through the holes in the bottom of the pan, and upon reaching the funnel would tumble down into the bottle, the funnel being too hot and too steep for the mites to remain long upon its surface. Mites may thus be collected from soil, dead leaves, straw, grass, moss, manure, and debris of various kinds.

A second method, which I employed with great success, was as follows: first, I would sift the mites from the materials in which they were contained, upon a white cloth (a large handkerchief is quite sufficient). This was done in the field. After a quantity of very fine debris containing minute organisms had thus been sifted upon the cloth, it was taken up and the contents poured into a large bottle. These siftings were taken to the laboratory and then poured out upon a hot plate, which was suspended over the top of a large funnel. The mites were driven out of the siftings by the intense heat and tumbled down through the funnel into a large bottle containing a little water, which prevented the mites from crawling out of the bottle. This method has several advantages over the Berlese method: first, it does away with the necessity of carrying home a large amount of material; second, an immense number of mites can be quickly collected in a small bottle, thus permitting one to gather large quantities of specimens in a short time; third, no dirt comes down

through the funnel along with the specimens. By the Berlese method, much dirt gets through the perforated pan into the collecting bottle.

Killing. Hot water or hot alcohol was used for killing specimens. The water or alcohol was first heated in a test tube and then poured into the collecting bottle upon the mites. The bottle should be immediately corked and well shaken. The hot water or alcohol causes the muscles to relax and the appendages to straighten out, so that the specimens are in excellent condition for dissection or for mounting.

Dissection. Many of the larger species were dissected, since without dissection it was impossible in many cases to use a high power lens to advantage.

Staining. Stains were often very useful with some of the smaller and more transparent forms. Various common stains were used, though eosin was generally preferred.

Mounting. The mounting of these minute arthropods is a rather delicate piece of work. The use of steel instruments should be avoided,--a small camel's hair brush being preferable. When the cover glass is applied there is great danger of crushing the specimen; and even if the coverglass does not crush the specimen, it will often force the palpi, pseudostigmata, dorsal bristles, etc., out of their normal positions. It is best to elevate the cover glass on glass supports or on glass or rubber rings, though with sufficient care, good mounts of the harder species can be made without supporting the cover glass. Canada balsam was used for mounting the larger and harder specimens, and glycerine jelly for the smaller and softer forms. I found

considerable difficulty in mounting the softer forms in Canada balsam. For every species at least three mounts should be made,--showing respectively the dorsal, ventral and lateral aspects.

Drawings. In making drawings, the proportions were obtained by the use of the Abbé camera lucida. It was frequently desirable to use an oil immersion objective, especially in studying the mouth parts. Drawings were made from live specimens, as far as possible.

CLASSIFICATION.

Order Acarina.

In Acarina the cephalothorax and abdomen are broadly united, the union being so complete that in many cases it is not visible. Four pairs of legs are present in the adult stage, with few exceptions (notably the Eriophyidae, which have but two pairs). Three pairs of legs are present in the nymph state, excepting Pteroptus, which has four pairs. Eyes are often present, sometimes consisting of only a median pair. The body is usually clothed with hairs or bristles. The mouth parts, consisting of mandibles and palpi, vary greatly in the different families. The mandibles are often chelate. Breathing is accomplished by means of a spiracle, situated usually at the sides of the body or close to the neck.

Family Demodicidae.

The body is wormlike; cephalothorax and abdomen united together without a line of demarkation. The palpi have three segments, the distal segment being hook-like; mandibles styliform. The trachae, stigmata and eyes are wanting. The larva are legless or else have three pairs of very small legs. The nymph has four pairs of leg stumps and is without epimera and sternum. The adults have four pairs of legs, each leg having three segments. These forms live in the skins of mammals.

Family Eriophyidae.

The members of this family have only two pairs of legs and each leg has five segments. The body has few hairs. A truncated piece is present at the apex of the abdomen). The abdomen terminates in a sucker. The cephalothorax often bears lines or ridges. Minute forms living on plants and often producing galls.

Family Sarcoptidae.

Body soft. Palpi small, three jointed. Ventral suckers usually present at genital opening or near anal opening. Eyes absent. Tarsi often with suckers. Rod-like epimera are present beneath the skin on the venter. Habits frequently parasitic.

Subfamily Cytolichinae. There are no genital suckers; vulva longitudinal. The skin has fine parallel lines. These mites live in the skin and cellular tissues of birds.

Subfamily Sarcoptinae. There are no genital suckers. The skin bears parallel lines. Vulva transverse. Living in the skin of mammals and birds.

Subfamily Analgesinae. No genital suckers. Skin with fine parallel lines. Parasitic on the plumage of birds.

Subfamily Listrophorinae. These mites possess special structural adaptations for clinging to the hairs of mammals. Genital suckers absent. Skin with fine parallel lines.

Subfamily Tyroglyphinae. Parasitic on bees only. Tarsi I and II with clavate hairs. Genital suckers usually present.

Skin usually without fine parallel lines. Tracheae absent.

Subfamily Canestrininae. Legs short. They live on insects. Genital suckers present. Skin usually without fine parallel lines. Trachae absent.

Subfamily Tarsoneminae. Forms with trachae. No ventral suckers. The legs end in claws. The body is divided into cephalothorax and abdomen. Not parasitic on birds or mammals.

Family Gamasidae.

Forms having a distinct spiracle on each side of the body above the third or fourth coxa. Skin leathery. Tarsi usually with a sucker. Hypostome small; venter without furrows. Eyes absent. Generally parasitic.

Subfamily Dermanyssinae. Mandibles fitted for piercing. Body often constricted. Parasitic on vertebrates.

Subfamily Uropodinae. First pair of legs inserted within the same body opening as the oral tube. Genital apertures surrounded by sternum. Body oval or shield like. Legs seldom extending much beyond the margin of the body. Mandibles slender. Usually there is a pedicel composed of excrement which serves to attach the uropod to the insect. Usually attached to insects.

Subfamily Gamasinae. Generally they are parasitic on insects or vertebrates. Male genital aperture usually on the anterior margin of sternal plate. Body flat and broad. Eyes absent. There are many hairs on the legs and body. Mouth parts often retractle. Mandibles normally chelate.

Family Oribatidae.

Cuticula thoroughly chitinized. Cephalothorax and abdomen usually divided by a transverse constriction between the second and third pairs of legs. Tracheae usually present, simple and unbrached. Immature forms without trachae. Stigmata, when existing, sunk in the acetabula of the coxae. Eyes absent. A pair of pseudostigmata, each bearing a pseudo-stigmatic organ is present on the dorsal surface of the cephalothorax. Mandibles chelate, rarely serrate. Genital openings abdominal in both sexes. No external sexual differences of structure. Larvae and nymphs with a soft or leathery cuticula.

Subfamily Hoploderminae. Cephalothorax movably attached to abdomen. Palpi with four segments. Pteromorphae absent. Dorsal surface of cephalothorax covered by a simple, more or less convex, chitinous plate. Ventral plate not anchylosed with the dorsal plate.

Subfamily Oribatinae. Abdomen with chitinous wing-like expansions (pteromorphae). Body globose or oblong.

Subfamily Apterogasterinae. Abdomen without wing-like expansions. Body of various forms.

Family Ixodidae.

A distinct spiracle is situated on each side of the body above or a little behind the third or the fourth coxa. Palpi free Skin often coriaceous or leathery. Tarse often with suckers. Hypostome large and furnished below with many recurved teeth.

Venter with furrows. Skin leathery. The palpi are short and stout, indistinctly composed of four segments. The genital opening is situated on the front of the sternal area slightly beyond the mouth orifice. The legs have six segments and arise close together. Parasitic on animals.

Subfamily Argasinae. Scutum and ventral shield absent. Mouth parts almost hidden from above. Stigmal plate between coxae III and IV.

Subfamily Ixodinae. Scutum present. Ventral shields sometimes present. Mouth parts prominent from above. Stigmal plate behind coxae IV.

Family Bdellidae.

The cephalothorax and abdomen are distinct. The mandibles are large, forming a beak. Body with few hairs. Palpi of four or five segments. Eyes present, sometimes median in position. The tarsi never end in suckers. The legs and palpi often have a few very long bristles. Living upon plants.

Subfamily Bdellinae. Palpi geniculate. Mandibles large. Cephalothorax with four long bristles above. Tarsus of leg I longer than tibia. Abdomen usually broadest at the shoulders. Legs long and slender; hind coxae well separated from the anterior pairs.

Subfamily Eupolinae. Soft bodied. Palpi never geniculate. Beak small. Distal joint of leg I shorter than the tibia. Eyes usually present. Palpi of four segments.

Family Trombididae.

The last segment of each palpus forms a thumb which acts in opposition to the preceeding segment, the latter ending in a claw, with few exceptions. Eyes usually present. Tarsi never terminate in suckers. Trunk divided into cephalothorax and abdomen.

Subfamily Caeculinae. Legs I and II with spinous processes. Integument leathery. Integumentary shields are present. Coxae contiguous, rectangular in form. Dorsum with a transverse furrow. The eyes are situated on pedicels. The ventral openings are large and close together, each being closed by means of valves

Subfamily Erythraeinae. Palpi moving in a sagital plane. Legs I not ending in long hairs. Coxae contiguous, radiate. Legs slender. Body with few hairs. Tarsi never swollen. The body shows no complete division between cephalothorax and abdomen and is short and broad. Two simple eyes. The legs terminate in two or three claws.

Subfamily Tetranychinae. Body oval with few hairs and those mostly long. The cephalothorax and abdomen are separated by a furrow. Eyes two. Palpi short, ending in a claw. Mandibles with basal segments united to form a plate and with the apical segments long and adapted for piercing plant tissues. Many of these mites spin.

Subfamily Trombidinae. A division exists between the cephalothorax and the abdomen. Cephalothorax very small. Mandibles chelate. Distal segment of leg I usually swollen. Body with many thick short hairs. Palpi prominent, of five segments. Thumb

large and usually clavate. Legs of seven segments and ending each in two claws.

Subfamily Rhyncholophinae. Cephalothorax large and in the same plane with the abdomen. Eyes sessile. Palpi prominent of five segments. Mandibles styliform, slender and retractile. The body and legs are well clothed with hairs or bristles. The genital opening is situated between the hind coxae.

Family Cheyletidae.

Tiny mites, distinguished typically by enormous palpi attached to a distinct beak. Palpi of from three to five segments and frequently with a minute movable subapical tubercle, which in some forms, is tipped with one or two pectinate bristles. Body oval. Skin soft, hairs few. Legs usually short and of five segments. In some species the front legs are transformed into grasping organs. The mandibles are fitted for piercing tissues. Male aperture posterior to the anus.

Family Hydrachnidae.

Aquatic. Body commonly short, nearly spherical with no division into cephalothorax and abdomen. Legs are close together. Eyes present, often close to the median line. Integument soft. Palpi of four or five segments. Legs usually of seven segments; coxae often broad and entirely united to venter. The tarsi terminate broadly and usually have two claws.

Subfamily Halacarinae. Mouth parts carried on a distinct beak. No ventral suckers. Marine forms.

Subfamily Hydrachninae. Mouth parts not carried on a beak. Suckers usually present near genital openings. Fresh-water forms.

HABITS.

Few arthropods have habits more interesting than those of the mites. The habits of all animals depend largely upon the food which they eat; so let us consider the kind of food that mites live upon. Mites are both herbivorous and carnivorous. The Oribatidae, according to Michael, who has studied that family very thoroughly, live largely upon fungi. The Gamasids are largely parasitic and can frequently be found on horses, cattle, moles, etc., as well as on birds and insects. One genus of Gamasids, Uropoda, is frequently found attached to beetles. They are fastened to the beetle by means of a pedicel, which is attached to the posterior part of the mite. This pedicel was at first thought to be a process belonging to the mite, and one which could be detached from the insect when the mite wished a new host. It was at length found, however, that the mite did not take the pedicel with it when it moved but that it detached itself from the pedicel. Now it seems to be proved that the pedicel is composed of excrement and that by a new excretion the mite can detach itself from the pedicel. In the case of Uropoda it appears that they attach themselves to the body of the insect purely for purposes of transportation. One will often find Coleoptera almost entirely covered with these Uropoda, which are shield-like in shape. I found a dead tumble-bug, the ventral parts of which were almost entirely hidden by these Uropoda. It has been reported that some mites will kill other Acarina, especially the nymphs, though this has been denied by many authorities. The Ixodidae, or ticks, are entirely parasitic and are familiar to most of us. They can

be seen on the undersides of many vertebrates, as well as in the ears of dogs, cats, rabbits and raccoons. I have many of them taken from the ears of a raccoon. The food of Bdellidae is perhaps very similar to that of Oribatidae. The Trombididae are doubtless largely phytophagous.

Where are the haunts or the homes of the mites? Those which are parasitic have just been referred to, namely, the Ixodidae, Gamasidae and the nymphs of several other families. The most common situations in which to find mites are under rocks, stones, boards, logs, dead leaves, straw, manure etc. Often you will find them under the bark of trees, under moss, on the leaves of trees, or crawling over potted plants and under straw piles and debris. Michael says that a favorite habitat for Oribatidae is under moss. I have found them under rubbish and leaves, but seldom under moss, though I have found many other forms in the latter situation. The Tetranychidae can be most often found crawling about on plants and flowers. The Trombidinae, I have often found crawling up the trunks of elm trees, especially on dry spring days. The Bdellidae are easily found in the fall or spring, simply by turning over boards or stones or dead leaves. Many of the non-parasitic Gamasidae occur in a great variety of places. The most abundant supply that I have ever obtained was from beneath a small stack of dead weeds on the University farm. The Hydrachnidae, as the name signifies, are usually found on the water or near it.

The mites retreat from the light as much as possible, and it is interesting to note in connection with this subject that many of them are blind. Mites will also go towards sources of

heat, and this fact is taken advantage of in the Berlese method of collecting mites in large quantity, as described elsewhere in this paper.

Some mites will "feign death" when touched, and other species will run away or else face an enemy. I often have noticed that the *Linopodes* when attacked will whirl around, facing the disturber and will not resume their march until they are no longer molested.

How do mites pass the winter? Most mites pass the winter in the adult stage; while others lay eggs, which hatch in the spring. I have dug into debris and under straw piles late in December and found many mites; some dormant but others moving slowly about. I have gone out in January, however, and turned up boards, rocks, etc. and have found scarcely any mites. Presumably they go down into the ground when the temperature falls below a certain point. I have turned up logs and boards in February, however, while the ground was still frozen and have found mites in considerable quantity, where in January I could find none. By the first of March mites begin to be numerous. In the laboratory I have found not a few nymphs crawling over books, boxes, etc., even in February.

The secondary sexual differences are often well marked in mites. As a rule, the female is larger than the opposite sex, but not always, however. *Trombidium locustarium* shows the secondary sexual characters very plainly. In this species the male is much smaller than the female and the body is pyriform in shape with a deep transverse furrow on the front of the dorsum; the female is larger, and her body is almost as broad behind as in

front; furthermore, she has no transverse furrow. In the case of some Gamasids the male has a spur on the second pair of legs which is used in clasping the female. The bodies of the females are often greatly distended with eggs. I have counted as many as a dozen eggs in the body of a female of the family Bdellidae.

A great many kinds of mites will sometimes be found living together or apparently so. Thus I have noticed no less than a dozen species of mites wintering under the same board.

LIFE HISTORY.

The life histories of mites vary greatly in the different families. Speaking generally, the life history of Acarina comprises four stages, namely, egg, larva, nymph and adult.

The eggs of Acarina have various forms. Those of Oribatidae are generally elliptical or cylindrical; sometimes they are slightly crescent shaped. The eggs have an outer membrane, which may be granulate or may be fashioned into irregular teeth. Often an inner membrane is formed around the embryo when the latter is developing. The number of eggs laid by one female varies greatly. I have counted as many as a dozen eggs in the body of one female of the family Bdellidae and have found as many as twenty-five eggs in the body of one of the Trombidinae. In some of the lower forms hundreds of eggs are laid by a single female. The eggs of most mites hatch soon after they are laid. It takes the larvae of some species several hours to hatch, though for most species the time is much less. Michael has observed some of the Oribatidae emerging from the eggs and describes the process as follows. When the embryo has become fully developed the egg splits along the inner membrane. The long legs of the larva are now folded upon the sides of the body and the long hairs of the back lie flat and are directed backward. First, the anterior part of the cephalothorax emerges from the egg; then the first pair of legs; and next, the whole of the cephalothorax. Now the second legs gradually make their appearance. A long delay then takes place, during which the various parts harden and

assume their permanent form and position. The hind legs remain in the shell until the last, assisting in the emergence of the mite by pushing against the wall of the egg. As the different parts emerge, all the appendages are kept in continual movement, a strange proceedure for these slow and lazy creatures. The legs are worked in all directions and the chelate mandibles, usually so difficult to see, are protruded and retracted independently and kept ceaselessly snapping.

The larvae of nearly all mites are hexapod. It is asserted that the larvae of *Pteroptus*, however, are octopod. Both the adults and larvae of Eriophyidae have only two pairs of legs. In most cases the larva bears but little resemblance to the adult. After emerging from the egg, the larvae feed a while and then pass into a resting stage.

During the nymphal period, the mite may moult once or twice. The nature of the internal changes during the nymphal stage has been the subject of much discussion. Mégnin in "Die Anatomie der Tyroglyphen" maintains that there is complete histolysis and complete histogenesis. Dr. Nalepa, however, as the result of a careful study of the development of *Trichodactylus anonymus*, denies the correctness of such a view. A. D. Michael has treated of this subject at considerable length, using several species, especially *Notaspis bipilis* and *Notaspis lucorum*, which are well adapted for the purpose, since their nymphs have a smooth, colorless, and highly transparent integument through which the highly colored alimentary canal and its diverticula are very conspicuous.

The observations of Michael may be summarised as follows:

First, histolysis is far from complete. In other words, there is not a complete breaking up of all the organs of the

nymph prior to the formation of those of the adult, but some of the organs are identical in both stages.

Second, where histolysis and histogenesis take place, they occur simultaneously.

Third, in the earlier stages of the transformation the contents of the nymphal skin shrink backward toward the posterior portion of the animal, leaving the cuticula of the rostrum etc. empty; furthermore, the tissues of the legs withdraw into the body cavity, leaving the cuticula of the legs empty.

Fourth, in the later stages of transformation, the organs of the adult have again advanced toward the rostrum of the nymphal cuticula.

The entire process of transformation in the nymph requires usually several days or even several weeks. As was stated, the life histories are very different in the different families, the following being a general summary of the life-history:

Bdellidae,- Eggs nearly spherical; larval and nymphal stages; both larva and nymph resemble the adult. Larva not parasitic.

Cheyletidae,--Eggs deposited often in clusters. The larvae upon hatching bear a close resemblance to the adults but have only six legs. Nymph-like adult. Parthenogenesis occurs in some species.

Erythraenae and Tetranychinae,- Eggs oval, many being produced by a single female. The larva and nymph both resemble the adult, except in having six legs.

Rhyncholophinae and Trombidinae,- Eggs oval, larva oval or circular in outline. Becoming attached usually to insects, they feed upon those until the body becomes swollen, then drop to the

ground and transform into adults.

Caeculidae,- Nothing is known as to the life history of this family.

Hydrachnidae,- The females lay their spherical eggs on water-plants, stones etc. The deutovum condition of the egg occurs. Larva six-legged. The larva upon hatching attaches itself to aquatic insects, and for this purpose is provided with sharp hooks at the tips of the short, stout palpi. The mouth parts of the larva, which are very small, are inserted into the host. The body becomes swollen and the legs shrink, giving the creature the appearance of an elliptical egg. The nymph is formed in this sac-like body, from which issues the adult mite.

Ixodidae,- The eggs of a single female may number ten thousand or more. As the eggs issue from the body they become coated with a viacous substance. The eggs are laid on the surface of the ground and hatch in a few days. The larva finds its host and attaches itself. After becoming distended with food, the larva drops off; then, after a few days the nymph issues from the old larval skin and hunts for a host. The nymph attaches itself to its host, becomes distended with food; drops to the ground and moults, revealing the adult.

Gamasidae,- The egg hatches into a soft-skinned, six-legged larva, very different in appearance from the adult, with the exception of *Pteroptus* and allied genera, which have eight legs on hatching. The larva moults and becomes an eight-legged nymph. The nymphal stage is often the longest and most active period of the life history. After a series of moults the adult stage is reached. The following names have been given to the different

nymphs in the order of their occurrence; protonymph, deutonymph, and tritonymph. During their nymphal stages, many species are attached to various insects for the purpose of transportation.

Oribatidae,- The eggs are sometimes deposited, and sometimes ripen in the body of the parent mite, the mother dying and her shell remaining as a protection for the eggs. The larva, however, has a soft skin. When the nymph is about to become an imago it seeks some sheltered spot and firmly fixes its legs to some object. In about ten days the imago appears.

Tarsoneminae,- The eggs develop within the body of the female, which causes the abdomen of a pregnant female to swell to an enormous size. Individuals develop within the mother and issue forth as sexually mature males and females.

Tyroglyphinae,- The eggs are large. The young on hatching are six-legged, but upon moulting, two more legs appear. From now on the process of development to adult the condition is simple. There may be, however, a "Hypopus" stage. The Hypopus is very different in appearance from the adult. It has sucking disks by means of which it attaches itself to insects or other creatures for the purpose of transportation. On finding a suitable situation, it moults into an octopod nymph, which develops into the adult mite.

Analgesinae,- Eggs large and elongate. Larva six- or four-legged. Some maintain that the six-legged form is a nymph. The nymph has the general form of an adult, but lacks genital organs, however. In some species the Hypopal condition develops from a nymph. The adult male develops directly from a nymph, but the female has a stage intermediate between the nymph and the adult.

Sarcoptidae,- The eggs are laid in the skin of animals. The newly hatched larva is six-legged, the last legs ending each in a long bristle. Some of the species moult four times before maturity.

Eriophyidae,- The eggs are laid on the surfaces of leaves. The young on emerging from the egg are helpless, being without tarsal appendages, but these soon appear, at the first moult. Moults occur before the adult stages are reached.

Demodecidae,- The egg is fusiform. The larva is hexapod, moults and becomes octopod. After two more moults maturity is attained. The nymphs greatly resemble the adults.

ANATOMY.

In Acarina, two regions, at most, are distinguishable: the thorax and abdomen, though frequently these two regions unite to form one. The appendages consist of four pairs of legs, the mandibles and the palpi. The body is often thickly clothed with hairs or bristles, though in some species it is naked.

The mouth parts consist of the mandibles and the palpi. To these are sometimes added other structures, as the lip, hypopharynx etc. The mandibles have usually two segments, of about equal length. Often the mandibles are chelate, the last segment opposing the penultimate one. The mandibles, furthermore, may be long and styliform, for the purpose of piercing. In certain Gamaridae the mandibles can be entirely withdrawn into the cephalothorax. The tips of the mandibles are always heavily chitized.

The palpi consist of from three to five segments. In some species the palpi are free; in others they are almost obsolete, being united with the rostrum. The palpi are often slender, ending in two or more large bristles, as in Bdellinae, for example. In this group they are exceptional in being geniculate. In many instances the palpi end each in a claw or a thumb, or both In the Trombididae the last segment of the palpus forms a thumb, which acts in opposition to the penultimate segment. In Oribatidae, Sarcoptidae, and Tetranychinae the palpi are rather short and are clothed with only a few short hairs. In Chelatidae, however, the palpi are very large with an enormous base and with special terminal modifications, consisting of a movable papilla

near the apex, and two or more pectinate bristles. In other mites the palpi end each in a single claw or hook, and have several stout spines. The mouth parts vary greatly in size but are very prominent in Gamasidae, Trombididae, Bdellidae and Chelatidae. In Oribatidae, however, they are very small and often obscure.

The cephalothorax, when distinct from the abdomen, varies greatly in its relative size. In Bdellidae it is almost as large as the abdomen but in Trombididae it is very small, often less than one tenth the size of the abdomen. The cephalothorax is prominent in Gamasidae, Oribatidae and Tetranychidae, and in these families is separated sharply from the abdomen. Eyes are present usually but not always; when present they are situated sometimes on the sides and sometimes on the median line. In Trombidinae they are situated on a stalk or "pedicel". In Oribatidae are found several peculiar structures, for example, the "pseudostigmata,"-small cylindrical, chitinous projections on the sides of the dorsal surface. Each pseudostigma has a "pseudostigmatic organ" projecting from its distal end. This organ varies in shape: it may be broad and stout, spindle shaped, styliform or pectinate. On each side of the cephalothorax in Oribatidae is a chitinous shelf-like expansion termed a "lamella"; below and in front of this is a slender chitinous projection known as a "tectopod". The front of the cephalothorax on the dorsal side often forms a "rostrum", and the region behind the rostrum is known as the "dorso vertex".

The abdomen is usually, though not always, the largest division of the body and bears but few external structures. On the ventral side, however, are situated the genital openings and

the anus, though in a few species the anus opens dorsally. The anal and genital openings in the case of the Oribatidae are provided with chitinous, folding valves which when closed completely cut off access to the exterior. On the ventral side of the abdomen in many of the mites, is a large ventral plate forming a part of the exoskeleton; often, also, an anal and a genital plate. On the dorsal side of the abdomen there is usually a large plate termed the "dorsum." In Oribatidae there is a prominent chitinous wing-like expansion on each side of the abdomen termed the "pteromorpha". The abdomen is frequently oval in form, but often globular, and in the genus Nothrus, rectangular. In Eriophydae the abdomen is vermiform with many segments.

The legs of Acarina vary greatly in form. Excepting in Eriophyidae, there are four pairs of legs in the adult. In the nymph there are usually three pairs. The legs in most families are stout. One, two or three claws are present at the distal end of the last segment. The number of segments in each leg varies from five to seven. In some instances the second pair of legs are much enlarged and are modified for the purpose of grasping. The front legs are generally more slender and sometimes much smaller than the others, being often used for tactile purposes. Such mites as are parasitic and such as adhere to other animals for the purpose of transportation, usually have legs that are adapted for clinging to their host.

Certain mites have always attracted more or less attention on account of their vivid colors. Thus the Bdellidae and Tetranychidae are usually bright red, the term "red spiders" being applied to members of the latter family. The Oribatidae are as

a rule either black or else dark brown, though there are several exceptions to this rule. Gamasidae are usually brown, but sometimes blackish, yellowish, pinkish or even greenish in hue. Most of the smaller forms, as Eriophydae, are inconspicuous as regards color. The Hydrachnidae are as a rule very highly colored, being red, scarlet, yellow, yellowish green etc., with spots of black or brown.

The texture of the integument varies greatly in the different forms. In Sarcoptidae and Eriophyidae the integument is rather soft. In Gamasidae and Ixodidae, however, it is leathery and tough, and sometimes very hard. The Oribatidae have a heavily chitinized integument, and on account of this were long known as "beetle mites." The body of mites is usually clothed with hairs, which vary greatly in size, form and number. Often the hairs are small and simple. Some of the Trombidinae, however, have feathery hairs and others clavate hairs. Pectinate bristles are frequent on the anterior part of the body and legs and in some genera over the entire surface of the body. The hairs are so thick in the case of some Trombidinae as to almost completely hide the integument, though certain Oribatidae, on the other hand, are hairless.

The study of the internal anatomy of Acarina is as difficult as it is interesting.

The following list of investigators and their works is very helpful for a study of the internal anatomy of Acarina.

Henking, H.

1882--"Beiträge zur Anatomie, Entwicklungsgesichichte und Biologie von Trombidium fuliginosum Herm." Zeits. für Wissen. Zool. vol. 37 pp. 553-663, 3 pl. Review

of same Jour. Roy. Micro. Soc. Ser. 2, vol. 3, 1883. pp. 210-211.

Mégnin, P.

1876--"Monographie de la Famille des Gamasidés." Jour. de La Anat. et Phys. 1876, pp. 288-336.

Michael, A. D.

1883--"British Oribatidae." Ray Soc. London, vol. 1, Chap. 10, pp. 142-190, pls. D.E.F.G.

1883--"Observations on the Anatomy of the Oribatidae." Jour. Ray. Mic. Soc. Ser. 3, vol. 3, 1883, pp. 1-22.

1889--"Observations on the Special Internal Anatomy of Uropoda Krameri" Jour. Ray. Mic. Soc. 1889, p. 1.

1893--"Variations in Internal Anatomy of Gamasinae" Review in Jour. Ray. Mic. Soc. 1893, pp. 736.

1894--"Notes on the Uropodinae" Jour. Ray. Micro. Soc. 1894, vol. 8, pp. 315-317.

1895--"Anatomy of Thyas petrophilus" Proc. Zool. Soc. 1895, pp. 174-209. (3 pls.) Rev. in Jour. Royal Micro. Soc. 1896, p. 60.

1895--"The Form and Proportions of the Brain in the Oribatidae and in some other Acarina." Jour. Ray. Micro. Soc. 1895, pp. 274-281, pl. 6.

1897--"Resume of the Anatomy of Bdella" Jour. Ray. Micro. Soc. 1897, p. 2, pp. 103-106.

Nicolet, M. H.

"Acariens des Environs de Paris" Chap. 4, pp. 410-415, pls. 1 and 2.

DESCRIPTION OF SPECIES.

FAMILY SARCOPTIDAE.

Subfamily Tyroglyphinae.

Tyroglyphus phylloxerae.

1874. C. V. Riley, Sixth Ann. Rept. Nox. and Ben. Insects of Mo. p. 52.

Average measurements,--Length, 70 mm.; breadth, 35 mm.; length of first pair of legs, 30 mm.; second pair, 30 mm.; third pair, 34 mm.; fourth pair, 36 mm.

The mandibles are short and scissor-like, one third as broad as long.

The palpi are small.

The cephalothorax is about one fourth as long as the body. The body is oval in shape, about two thirds as broad as long. There are several long hairs on the dorsum of the abdomen, they are about as long as the body.

The posterior pair of legs is longer than the rest. The tibia of each pair of legs has a long bristle at its distal end; tarsus with single claw; claw one third as thick as long.

Color of mite is a light yellowish green.

The integument is smooth and soft.

Distribution,--

United States, described by C. V. Riley, Missouri.

United States, collected by Mr. West, Urbana, Illinois.

This mite lives on the roots of plants and in its hypopal stage is attached to insects.

FAMILY GAMASIDAE.

Subfamily Uropodinae.

Alliba n.sp.(?) .

Average measurements,--Length, .66 mm.; breadth, .56 mm.; length of first pair of legs, .12 mm.; second pair, .12 mm.; third pair, .24 mm.; fourth pair, .26 mm.

The body is almost circular in shape, but a little longer than broad. The posterior pair of legs are situated about two thirds the distance from the anterior to the posterior end of the body.

The anterior pair of legs is small, not extending beyond the margin of the body; the other three pairs are subequal and extend about half their length beyond the margin of the body. The coxa is the largest segment and each segment gets a little smaller than the preceding as we count out from the body. The legs have a few very stout, short, sharp bristles about one third as broad as long; claws are small and curved with a large sucker between them.

Color of mite is brown.

The skin is thick and hard, body with a very thick shell-like cuticle; cuticle on legs not so thick; surface smooth.

Distribution,--

United States, collected by myself, Urbana, Illinois. This mite is parasitic on Coleoptera.

Subfamily Gamasinae.

Holostaspis n.sp.(?) , pl. 1, fig. 1.

Average measurements,--Length, 1.20 mm.; breadth, .80 mm.; length of palpi, .60 mm.; first pair of legs, 1.20 mm.; second pair, 1.08 mm.; third pair, 1.10 mm.; fourth pair, 1.60 mm.

The mandibles extend almost to the end of the palpi; one finger ends in a straight point, the other is semicircular; there is no spur or flagellum. Cusps of hypostome one half as long as mandibles.

The palpi are two fifths as long as leg I; anti penultimate segment twice as long as penultimate; distal segment very short, with about a dozen bristles.

The body is oval, three fifths as broad as long; two straight short bristles are present on the crown of the cephalothorax; two pairs of short equal clavate bristles on the shoulders; two pairs of clavate bristles on the dorsal, posterior margin of the abdomen; anal plate broader than long and larger than sternal plate, which is of uniform length and breadth.

The anterior pair of legs is a little longer than the body; posterior pair considerably longer; coxa of leg I, twice as long as broad; segment two, two thirds as long as coxa, segment three very small, one third as long as two, and about three fifths as broad as two; tibia and tarsus subequal in length, both well clothed with hairs; tarsus ends in about a dozen and a half bristles, two of which are somewhat longer than the rest. The bristles of the hind legs are especially stout, a long bristle is situated at about the middle of the tarsus on the inner side.

Light brown in color.

The skin is thick but brittle; surface rough; dermis of hind legs especially thick.

Distribution,--
United States, collected by myself, Urbana, Illinois.

<u>Seius</u> n.sp.(?) .

Average measurements,--length, .60 mm.; breadth, .50 mm.; length of first pair of legs, .40 mm.; second pair, .32 mm.; third pair, .30 mm.; fourth pair, .40 mm.

The mandibles are very small, they do not extend in front of the margin of rostrum, consist of a long pair of pinchers with curved tips.

The palpi are two thirds as long as legs I; segment two, the longest, being three times as long as broad; segment three, three fourths as long as two; segment four, three fourths as long as three; distal segment very short, being hardly one half as long as the penultimate, and is narrower than the other segments and bears several short bristles at the end; segments two and three each have a short bristle on their median sides.

The body is oval, two thirds as broad as long, and has a very few short hairs; about five clavate bristles on the sides of the body towards the anterior end, they are curved towards the median plane and point backwards.

The anterior pair of legs is as long as the body, the other legs are about two thirds as long. The front pair of legs are quite crooked, being almost in an S shape. Segments one and two are subequal; three is very short, one half as long as broad; four, five, and six are subequal, each being about twice as long

as two; the tarsus is a little longer than the tibia and ends in two small claws; the tarsus has many short hairs.

The mite is a uniform light brown in color.

The skin is tough and hard, surface almost smooth.

Distribution,--

United States, collected by myself, Galesburg, Illinois.
United States, collected by myself, Urbana, Illinois.

Seius hirsutus.

1900, A. Berlese, Gli Acari Agrarii, p. 41.

Average measurements,--Length, .50 mm.; breadth, .28 mm.; length of palpi, .12 mm.; first pair of legs, .52 mm.; second pair, .40 mm.; third pair, .40 mm.; fourth pair, .52 mm.

The mandibles are small and short.

The palpi are about one third as long again as segment three of leg I; segment two is as broad as long; segment three is twice as long as two; segments four and five subequal; segment five has a few small bristles on the end; palpi about as broad at the end as at the base.

The body is about three fifths as broad as long, almost rectangular and has many large, long, curved bristles; there is a row of large curved bristles all the way round the margin of the body; the bristles are longest at the posterior margin where there are four about the same length as the palpi; there is a pair of thick bristles on the shoulders which project at about right angles to the surface; just behind these the bristles are very short and much curved, the first pair being about one half as long as the shoulder bristles.

The anterior and posterior pairs of legs are longer than the

body; the other two pair are about as long as the body. The tarsus of leg I is twice as long as the tibia; the coxa is a little longer than segment two; segment three is very small being about one half as long as two; segment four is about as long as the coxa and segment two taken together; segments five and six subequal, each has two pairs of short, stout bristles; all the legs have short, stout bristles.

Specimens are a light brown in color; the legs are lighter than the body.

The skin is very thick and hard; the body is covered with pits making the surface very irregular.

Distribution,--

United States, collected by myself, Urbana, Illinois.
Found under dead leaves and under trash.

FAMILY ORIBATIDAE.

Subfamily Hoploderminae.

Phthiracarus n.sp. ,pl.4,fig.2.

Average measurements,--length, .70 mm.; thickness, .36 mm.; length of first pair of legs, .24 mm.; second pair, .20 mm.; third pair, .20 mm.; fourth pair, .20 mm.

The cephalothorax is twice as long as thick; mandibles very prominent and stout and can be retracted so that they are invisible; pseudostigmatic organ clavate; a pair of hairs about two thirds as long as the cephalothorax is situated at the posterior margin of the same; in front of this pair is a similar pair about two thirds as long; the rostral hairs are about two thirds as long as this pair.

The abdomen is about three fifths as thick, as long and is very narrow; on the dorsum are five pairs of long bristles of equal length; on the posterior ventral surface are four pairs of short, straight bristles; the abdomen is curved with small pits, rounded behind and truncated in front.

The legs are subequal; as long as cephalothorax; claws tridactyle, half as long as tarsus; the tarsus is twice as long as the tibia and has many long hairs; the tarsus of leg I has very long tactile bristle, half as long again as the tarsus itself; the tibia and genual are subequal.

The body is a dark brown; the legs are much lighter.

The integument is hard and resistant and well chitinized; the integument of legs not so thick as that of the body. The body is covered with small pits.

Distribution,--

United States, collected by myself, Danville, Illinois.
Found under logs and boards.

Subfamily Oribatinae.

Oribata lucasi Nicolet

1855, M. H. Nicolet, Arch. Mus. Paris, vol. 7, p. 432, pl. 4, fig. 2.

1884, A. D. Michael, British Oribatidae, vol. 1, p. 262, pl. 11, fig. 1-5.

1898, A. D. Michael, Das Tier., Lief. 3, p. 22.

1901, I. Tragardh, Arachniden aus Agypten und dem Sudan p. 122.

Average measurements,--length, 60 mm.; breadth, 40 mm.; length of first pair of legs, 32 mm.; second pair, 24 mm.; third pair, 24 mm.; fourth pair, 30 mm.

The cephalothorax is pyramidal in shape; lamellae short

with very small cusps; two pairs of rostral hairs, both pairs denticulate, the anterior pair is shortest and projects almost directly forwards but curved slightly towards the median plane. The hind pair is straight and is directed forwards. The interlamellar hairs are as long as the posterior rostral hairs, they are denticulate and slightly curved away from the median plane. The pseudostigmatic organ is clavate and is as long as the femur.

The abdomen is oblong; the pteromorphae extending beyond the margin of the abdomen and cephalothorax; pteromorphae truncated. The abdomen has a few very minute hairs; the anal plates are twice as long as broad, and are approximate to the posterior margin of the ventral plate and twice its length behind the genital plates. The genital plates are one half as large as the anal plates. The ventral plate is of medium size.

The legs are short and stout, subequal in length. The first pair is two thirds as long as the body. The tarsus, femur and tibia are all of about the same length. The femur is over one half as thick as long. The genual is very small being about one third as long as the femur. The tibia is broad and square at its distal end and at this end carries a long bristle which is twice as long as the segment itself. There is a similar bristle situated at the same place on the other legs.

The color of the abdomen is a very dark brown, legs lighter. The anterior part of the abdomen and the posterior part of the cephalothorax is black.

The skin is thick and very resistant; surface smooth.

Distribution,--

Algeria

France, reported by M. H. Nicolet, commonly distributed.

England, reported by A. D. Michael, generally distributed.
United States, collected by myself, Urbana, Illinois.
Egypt, collected by Swedish Zool. Exp. L. A. Jagerskidd. Found under boards and in rubbish.

Oribata n.sp. ,pl.3.fig.3.

Average measurements,--length,.80 mm.; breadth,.50 mm.; length of first pair of legs,.36 mm.; second pair,.32 mm.; third pair,.32 mm.; fourth pair,.34 mm.

Lamella absent; rostrum thick with rounded anterior end; rostral hairs curved and pectinate. The tectopod is blade-like and two thirds as long as the rostrum. The pseudo-stigmatic organ is clavate and pectinated. It is about as long as the tarsus of leg I. The interlamellar hairs are thick and pectinated.

The abdomen is slightly pyriform and hairless. The pteromorphae are sharp pointed and extend forwards almost to the tip of the rostrum. The anal and genital openings are far apart. There is an anal process about half as long as thick also a genital process about two thirds as large as the anal process.

The females have a long segmented ovipositor which is thrust out upon killing with hot water. It is about as long as the body and is forked at the end.

The first pair of legs is twice as long as the cephalothorax. The tarsus is the longest segment, it bears a large plumose hair about one third the distance from the proximal end of the segment. The tibia is much thicker than the tarsus and is globose at its distal end; it is about two thirds as long as the tarsus. The genual is as long as the tibia, but only about half as thick. The femur is large; the coxa small. The legs are subequal in

length: fourth pair longest; the second pair has a very thick femura.

The body is a dark brown, the legs are lighter.

Integument smooth and polished on the abdomen; the cephalothorax is a little rough. The integument is well chitinized, and exceptionally hard.

Distribution,--

United States, collected by myself, Urbana, Illinois.

Subfamily Apterogasterinae.

Damaeus sufflexus Michael .

1885, A. D. Michael, Jour. Roy. Micro. Soc., ser. 2, vol. 5, p.394.

1888, A. D. Michael, British Oribatidae, vol.2, p.415, pl.34, figs. 9, 10.

1895, A. Berlese, (Belba sufflexa).A. M. S., fasc. 74, nr. 4.

1898, A. D. Michael, Oribatidae, Das Tier., Lief. 3, p. 58.

The rostrum is of medium length and slightly pointed at the apex. Lamella absent. There are no lamellar hairs, but there is a pair of similar stout, slightly curved hairs. Pseudostigmata long, projecting, nearly upright, cylindrical in shape. The pseudostigmatic organs are very long, about as long as the cephalathorax, rod-like in shape. The general shape of the cephalothorax is subrectangular, excepting the rostrum being a little wider than long. There is a rather large boss under the pseudostigmata.

The abdomen is globular; progaster rounded. The notogaster bears a row of about five short, stout, slightly curved hairs on each side, which project slightly over the margin of the abdomen.

The ventral plate is small. The anal and genital plates are of almost exactly the same size and shape with a very small margin between them.

The legs are rather long, of medium thickness, and well represent the type Damaeus. The femur of leg I is twice as long as the genual and bears two large bristles on the outer distal margin. The genual is two thirds the length of the tibia; the tibia is two thirds the length of the tarsus. The tarsus bears a very thick bristle on the proximal, outer margin and tapers toward the distal end.

The color of the body is light brown; the legs are almost yellow.

The cephalothorax is dull; integument slightly rough; abdomen smooth, not polished.

Distribution,--

England, collected by E. Bostock at Stone, Staffordshire.
England, collected by A. D. Michael at Keswick, Cumberland.
Italy, collected by A. Berlese.
United States, collected by J. W. Folsom at Dedham, Mass.

In England it was found only in moss on the ground. In America the single specimen was found under a rotten log.

Damaeus tecticola Michael .

1888, A. D. Michael, British Oribatidae, vol. 2, p.416, pl. 35.
1893, L. Karpelles, (Belba mirabilis) Math. naturw. Ber. Ungarn., vol. 2, p. 85.
1895, A. Berlese, A. M. S., fasc. 77, nr. 9.
1898, A. D. Michael, Das Tier., Lief. 3, p. 58.

Average measurements,--length, .54 mm.; breadth, .42 mm.; length of first pair of legs, .56 mm.; second pair, .44 mm.; third pair, .60 mm.; fourth pair, .90 mm.

The cephalothorax is broader than long; rostrum of medium length and rounded in front; lamellae absent; rostral hairs stout and curved very much towards the median plane; palpi of five segments and in the shape of a figure three, pointed towards the distal end and ending in two very short bristles; basal segment much the longest. The second segment of the palpus is one third as long as segment I, three and one half as long as segment II, four and five subequal. The pseudostigmatic organ is setiform, as long as femur of leg I, it is denticulate.

The abdomen is globular, broader than long. It has about eight short, thick, curved, denticulate, equal bristles; ventral plate of medium size; anal plates situated about their length from dorsal margin of abdomen, and one half their length from the genital plates; they are a little longer and slightly narrower than the genital plates.

The legs are very long; hind pair much the longest. The first pair of legs are half again as long as the body. The femur and tarsus are of almost the same length; femur curved at its proximal end, distal end clavate. The genual is small and short, scarcely one third as long as femur; tibia twice as long as genual, tarsus is almost globular at its proximal end. The legs possess many stout, curved, denticulate bristles. All the segments except the genual are clavate.

A uniform rather dark brown color.

The skin is very thick and tough; not polished and not smooth, covered on the abdomen with many minute depressions.

Distribution,--

England, collected by A. D. Michael in Warwickshire.
Italy, reported by A. Berlese.
United States, collected by myself, Urbana, Illinois.

In England the specimens were collected from the thatch of an old cottage which was being pulled down. I collected specimens from under boards and rubbish. Specimens have been collected from moss.

Liacarus n.sp. .

Average measurements,--length,.50 mm.; breadth,.32 mm.; length of first pair of legs,.26 mm.; second pair,.22mm.; third pair, .20 mm.; fourth pair, .24 mm.

The cephalothorax is rather short; lamellae one third as long as cephalothorax; rostrum thick but somewhat pointed; rostral hairs long, curved slightly towards the median line, pectinated. The palpi are large, have four segments, proxinal and distal segment each with a curved bristle; pseudostigmata small; pseudostigmatic organ as long as femur of leg I, narrow at the base, clavate in shape but pointed at the end. The inter lamellar hairs are twice as long as the pseudostigmatic organ.

The abdomen is almost globose. The progaster curves convexly down to meet the cephalothorax. There are a few very short hairs on the abdomen; ventral plate large; anal plates situated approximate to dorsal margin of abdomen. The anal plates are situated approximate to the dorsal margin of abdomen; they are over twice as large as the genital plates. Genital plates situated three times their length in front of the anal plates.

The legs are subequal in length; in pair I the femur and

tarsus are of almost the same length. The tibia is four fifths as long as the femur; the genual is one half as long as the tibia. There are no long bristles on the first pair of legs, tibia of leg III has a bristle as long as the segment itself; legs III and IV each have a similar bristle.

The mite is of a uniform brown color.

The integument is smooth and somewhat delicate in texture.

Distribution,--

United States, collected by myself, Urbana, Illinois.

Notaspis aequalis Michael

1890, A. D. Michael, Proc. Zool. Soc. Lond., pl. 37, fig. 5.

1898, A. D. Michael, Das Tier., Lief. 3, p. 46.

Average measurements,--length, .40 mm.; breadth, .26 mm.

The cephalothorax is broad; rather pointed in front; lamella broad, cusps of lamella with a long point; rostrum broad; rostral hairs as long as femur of leg I and slightly curved towards the median line, hairs denticulate; interlamellar hairs long, denticulate, almost straight and slightly converging towards the median plane; pseudostigmatic organ short and thick, club shaped.

The abdomen is globose. The progaster has a boss on each side which bears a large bristle which is curved and points slightly backwards. The abdomen has a very few short hairs; ventral plate large; anal plates almost approximate to the margin of abdomen; they are half as large again as the genital plates which are situated at a distance equal to twice the length of the anal plates in front of the same.

The posterior pair of legs is longest; they are about as long as the abdomen.

The anterior pair is three fourths as long as the posterior pair. The femur and tarsus of the first pair are subequal in length; the femur is two thirds as broad as long; the genual is one third as long as the femur; the tibia is as long as the tarsus and three times as broad at the distal end as at the proximal end. There is a long bristle on the tibia of leg I, as long as the segment itself. A similar but somewhat shorter bristle is present on the anterior edge of the femur of leg III and the tibia of leg IV.

The mite is a uniform brown in color.

The integument is smooth and moderately tough.

Distribution,--

Algeria.
United States, collected by myself, Urbana, Illinois.
Found under boards and rubbish.

<u>Notaspis</u> n. sp. . pl. 4, fig. 1.

Average measurements,--length, .50 mm.; breadth, .28 mm.; length of first pair of legs .30 mm.; second pair, .32 mm.; third pair, .36 mm.; fourth pair, .46 mm.

The rostrum is broad; lamellae small and truncated, about one third the length of the cephalothorax. Translamella absent; pseudostigmata very small and on the dorsolatteral part of the cephalothorax; pseudostigmatic organ rather slender, pectinated and slightly club-shaped. The general shape of the cephalothorax is that of an irosceles triangle with the base of the cephalothorax corresponding to the base of the triangle.

The abdomen is slightly oval and tapers towards the posterior end. The progaster curves convexly down to meet the cepha-

lothorax. The abdomen has about twelve short slightly curved bristles; ventral plate large; anal plates are large and are situated approximate to the dorsal margin of the abdomen and about twice their length from the genital plates, which are about three fifths as large as the anal plates and are situated very near the anterior margin of the ventral plate.

The first pair of legs are almost as long as the body and each succeeding pair is longer than the preceeding. The tarsus of the first pair of legs is stout and tapering. The coxa of the third pair of legs are globular and bear a large bristle each on the anterior margin.

The tibia of the fourth pair of legs bears on the anterior distal margin a large bristle as long as the tibia itself. The genual of all the legs is very short; in the third leg it is about one third the length of the tibia.

The color of the mite is a light yellowish brown.

The texture is slightly rough, unpolished; the dorsum of the abdomen is rougher than the rest of the body.

Distribution,--

United States, collected by myself, Urbana, Illinois.
Found under boards and debris.

FAMILY BDELLIDAE.

Subfamily Bdellinae.

Bdella peregrina Banks, pl.5, fig.1.

1894, N. Banks, Trans. Amer. Entom. Soc., vol.21, p. 219.
1895, N. Banks, Ann. N. Y. Acad. Sci., vol. 8, p. 433.

Average length, 1.40 mm.; breadth, .66 mm.; length of man-

dibles, .44 mm.; palpi, .62 mm.; first pair of legs, .80 mm.; second pair, 1.mm.; third pair, 1.10 mm.; fourth pair, 1.30 mm.

The mandibles are stout, about as long as the cephalothorax. A pair of large bristles is present about one third the distance from the end of each mandible.

The palpi are as long as the mandibles; second segment is the longest, the distal segment is almost as long as the second; segments three plus four are less than half as long as the distal segment. At the end of the distal segment are two bristles of equal length, being about two thirds the length of the distal segment. Segments two and five each have about six small bristles.

The cephalothorax is about as long as broad and slightly concave; anteriorly it is drawn out to form a neck. On each side at the posterior dorsal region are three eyes; the middle one is smaller than the others. There are two paramedian, dorsal bristles directed forwards and about as long as femur of leg I. There are three other small bristles on each side of cephalothorax.

The abdomen is oblong, about half as long again as cephalothorax. Anteriorly on each side are two moderately large bristles, the anterior being the longer. Posteriorly there are two pairs of short, stout, curved bristles; the more median pair being about half as long as the other pair.

The anterior part of the abdomen is about half as broad again as the posterior part.

The posterior pair of legs is longest. In the first pair the tarsus is the longest segment, being a little longer than the femur. It carries a stout, short bristle in front near the distal end. The tibia is about half as long as the tarsus; segments

three and four are of about equal length, each being about two thirds as long as the tibia. The first and second pairs of legs, subequal. The third pair is a little longer and has one bristle a little larger than the rest, on the distal end of the tibia.

The general color is orange red, with large black areas; one large area on the median line of cephalothorax. There are three large spots on each side of the abdomen; legs and palpi much paler, almost colorless; neck very pale; integument rough.

Distribution,--

United States, reported by N. Banks, Sea Cliff, N. Y.
United States, collected by Baker, Fort Collins, Colorado.
United States, collected by myself, Urbana, Illinois.

All the specimens reported have been found under boards and rubbish.

Bdella silvaticus Kramer .

1895, Sig. Thor (scirus s.) Norwegische Bdellidae II, Zool. Anz., Bd. 29, nr. 7, pp. 204-205.

Average measurements,--length 1.04 mm.; breadth, .58 mm.; length of mandibles, .36 mm.; of palpi, .54 mm.; first pair of legs, .72 mm.; second pair, .68 mm.; third pair, .78 mm.; fourth pair, .82 mm.

The mandibles are thick at the base and taper to a fine point at the apex; they are two thirds as long as cephalothorax; two bristles are situated on each side close to the base, the anterior is the longer; there is one bristle on each side on third the distance from the tip of the mandibles.

The palpi are half as long again as the mandibles; the second segment is longest, it is almost as long as the mandibles;

third segment is one half as long as the fourth, both together almost as long as the distal segment.

The distal segment bears two long bristles at the tip; the outer is the longer, being almost as long as the mandibles; two rather large, but much smaller bristles on the sides of the segment.

The cephalothorax comes down rapidly in front to form a short neck; sides convex. There is a pair of long bristles on the cephalothorax that points forward, about two thirds as long as segment two of palpus.

The abdomen is oval in shape, almost spherical; posterior margin bears four pair of short, stout, bristles subequal in length. There are a few short hairs around the sides of the abdomen.

The two hind pairs of legs are longest and of almost equal length; two front pairs are shorter and also of almost the same length. The first pair of legs is a little longer than the palpus; the tarsus is the longest segment; femur almost as long; segment three two thirds as long as four; both together as long as tarsus. There is a long bristle on the distal end of tibia of leg I, a similar but longer bristle on tibia of leg four and a bristle on the proximal end of tarsus of leg four as long as the segment itself; a similar but not so long a bristle on the tarsus of leg three.

The abdomen is a dark brown color, almost black; the rest of the body is colored orange. The legs and palpi are lighter in color.

The texture of the integument is moderately smooth and rather tough.

Distribution,--

Norway, described by Sig. Thor.

United States, collected by myself, Urbana, Illinois.

Collections were made from under boards and rubbish.

<u>Bdella</u> <u>tenuirostris</u> Koch . pl.6, figs.1,2. pl.7, figs.1,2.

1834, C. L. Koch, Deutschl. Crust. Miriap. Arach.,Hef.23, Taf.18.

Average measurements,--length, .74 mm.; breadth, .40 mm.; length of mandibles, .24 mm.; palpi, .40 mm.; first pair of legs, .62 mm.; second pair, .50 mm.; third pair, .74 mm.; fourth pair, .38 mm.

The mandibles are about half as long as the body, not stout, but tapering; on each side of the mandibles are four small, slightly curved bristles.

The palpi are about as long as the mandibles; the second segment is almost three times as long as the distal segment; segments three and four of equal length; both together about three fourths the length of the distal segment. Distal segment ends abruptly, the distal end being broader than the proximal. At the distal end are two long bristles, the outer is the longest, being as long as segment two of palpus.

The general shape of the thorax is that of an isosceles trapezoid with the sides slightly concave, and the upper side about one third the width of the base; on each side at the posterior margin are two eyes, in front of which on each side there is a short bristle. A large pair of bristles are situated on the anterior dorsal part of the cephalothorax. Between the pair of eyes are two somewhat small bristles.

The abdomen is about two thirds as wide as long; on the dorsum are

two rows of rather large bristles also a row of similar bristles around the margin; on the posterior margin is situated two pairs of moderately large bristles of equal size and length.

The posterior pair of legs is the largest and longest. The first pair is about half as long again as the palpus; the tibia and tarsus, the longest segments are subequal; segments three and four subequal, taken together they are as long as the tibia; femur three fourths as long as the tibia. The second pair of legs are the smallest; the third pair are almost as long as the fourth pair. The proximal end of tarsus three and four each carries a long bristle. The tibia of four also has a long bristle, about one half the length of the bristle on the tarsus.

Most of the mandibles, the cephalothorax, the legs and antennae are a reddish pink. The tips of the legs, mandibles, and posterior part of the cephalothorax and anterior part of the abdomen are a very pale, greenish, yellow; the rest of the abdomen is green except a part of the posterior end which is red.

The skin is rough and not as tough as usual.

Distribution,--

Germany, described by C. L. Koch.

United States, collected by myself, Urbana, Illinois.

Bdella n.sp. .

Average measurements,--length, .64 mm.; breadth, .32 mm.; length of mandibles, .16 mm.; palpi, .22 mm.; first pair of legs, . 36 mm.; second pair, .34 mm.; third pair, .40 mm.; fourth pair, .56 mm.

The mandibles are short and stout, being a little over half

as long as the cephalothorax. There is a bristle on each side of the mandibles close to the base, and one on each side about one third the distance from the tip.

The palpi are a little longer than the mandibles; segment two longest, almost as long as the mandibles. The distal segment is about half as long and broader at the tip than the base. At the end there are two long bristles, the outer is the longer, being as long as the mandibles; two short bristles on the outside edge of the segment; segments three and four broader than long.

The cephalothorax is much longer than broad, sides convex.

The abdomen is long and oval. There are four short bristles near the median line on the posterior margin of the abdomen.

The legs are subequal, the posterior pair is slightly the longest. The second pair is shortest.

The tarsus of leg one is the longest segment; tibia two thirds as long as the tarsus; femur as long as the tibia; segments three and four subequal, taken together a little longer than the tibia. Tibia of leg one bears a long bristle near the distal end. The tarsus of leg three and four each bears a similar bristle.

The mite is almost a uniform light yellowish-brown in color. The appendages are lighter than the body.

The surface of the integument is smooth. Skin not as tough as usual.

Distribution,--

United States, collected by myself, Urbana, Illinois.

Bdella n.sp. , pl.7, fig.3

Average measurements,--length, .60 mm.; breadth, .26 mm.; length of mandibles, .20 mm.; palpi, .30 mm.; first pair of legs, .44 mm.; second pair, .38 mm.; third pair, .52 mm.; fourth pair, .56 mm.

The mandibles are short and broad at the base; at the middle on each side is a large curved bristle and at the base on each side is a similar bristle of about one half the length of the first named.

The palpi are longer than the mandibles; second segment much the longest being almost as long as the mandibles; fourth segment not quite as long as the third, both together as long as the distal segment; distal segment broader at the tip than at the base and bearing two large bristles, the inner of which is spiral shaped, very characteristic of this species. Two small bristles are situated at the base of the larger ones.

The cephalothorax is longer than broad with a neck in front, sides convex. At about the middle on each side is situated a very long bristle, as long as the mandibles, behind which are the eyes, two on each side. Just behind the eyes and a little median to them are two bristles which point outwards and backwards. Lateral to these on the margin is a pair of bristles equal in length to the former.

The abdomen is oval, tapering slightly towards the posterior end. It has a row of bristles on the dorsum on each side about four in number. There are several bristles on the posterior margin of the abdomen. There are two larger than the rest, very close to the median line.

The legs are of about the same length. The second pair is

shortest. The tibia of leg one is about two thirds the length of the tarsus the longest segment; segments three and four are subequal; together they are as long as the tibia; the femur is large, almost as long as the tarsus. The tarsus of leg three bears at its proximal end a very long bristle, as long as the segment itself. The tarsus of leg IV has a similar bristle, also one not quite so long is on the tibia.

The color of the body is yellow with a shade of green. The sides of the thorax, the palpi and the legs are rose red.

The integument is moderately rough and moderately tough.

Distribution,--

United States, collected by myself, Urbana, Illinois.

Bdella n.sp. .

Average measurements,--length, .90 mm.; breadth, .42 mm.; length of mandibles, .40 mm.; palpi, .60 mm.; first pair of legs, .66 mm.; second pair, .60 mm.; third pair, .66 mm.; fourth, .80 mm.

The mandibles are long and narrow, carrying two bristles on each side close to the center. The posterior bristle is longer than the anterior.

The palpi are a little longer than the mandibles; the second segment is two thirds as long as the mandibles; distal segment half as long as segment two and carrying two bristles on the end; the outer bristle is as long as the segment itself; the inner bristle is about two thirds as long; on the side of the segment is a similar bristle; segment four is two thirds as long as distal segment; segment three one half as long as four.

The cephalothorax is longer than broad, sides concave; on each side is a long erect bristle one third as long as the man-

dibles. There are three eyes on each side of the cephalothorax situated near the posterior margin of the same. The ocular region of the cephalothorax is very convex.

The abdomen is globular, it has about eight short bristles on the posterior margin.

The first two pairs of legs are subequal and are shorter than the two posterior pairs, which are subequal. The tarsus and femur of leg I are subequal; the tibia is about two thirds as long as the tarsus; segments three and four are subequal, together they are about as long as the tibia. There are no long bristles on the legs.

The legs, palpi, mandibles and the anterior part of the cephalothorax are yellow, the rest of the body is yellow spotted with purple.

The surface of the integument is almost smooth; integument tough.

Bdella n.sp. .pl.8, figs.2,3,4. pl.9. fig.1.

Average measurements,--length, 1.20 mm.; breadth, 2 mm.; length of mandibles, .38 mm.; palpi, .36 mm.; first pair of legs, .80 mm.; second pair, .74 mm.; third pair, .96 mm.; fourth pair, 1.10 mm.

The mandibles are thick, about as long as cephalothorax, broad at the base; two large bristles on each side near the end, and a small bristle on each side at the base.

The second segment of the palpus is as long as the mandibles, third and fourth segments of equal length, both taken together are half as long as the distal segment, distal segment has two large bristles at the end, the outer about as long as segment

two, the inner almost as long as the outer.

The cephalothorax is broader than long, sides convex; two long bristles in front at the sides, pointing forwards and about as long as the femur of leg I, two much smaller bristles on each side, posterior to the larger ones, the hind pair is the longer, three eyes on each side at the posterior, dorsal margin.

The abdomen is large and broad, almost as broad at the posterior end as at the anterior end. The progaster has two bristles on each side, the anterior twice as large as the posterior. The posterior margin of the notogaster has two pairs of large bristles near the median line and two smaller pairs about two thirds as long, farther away from the median line.

The third and fourth pairs of legs are subequal. The fourth pair is much thicker than the third. The first pair of legs are longer than the second pair; the tarsus is the longest segment, with the tibia and femur almost as long; segment three and four equal, both together almost as long as the tibia. No long bristles on the legs.

The mite is a vermillion red in color. The legs are not so dark.

The integument ~~texture~~ is rough and covered with very small pits.

Distribution,--

United States, collected by myself, Urbana, Illinois.

Subfamily Eupodinae.

Linopodes antennaepes Banks .

1894, N. Banks, New American Acarina, Trans. Amer. Entom. Soc.

1905, N. Banks, The Acarina or Mites, Proc. U.S. Nat. Mus.,vol. 28, p. 13.

Average measurements,--length, .56 mm.; breadth, .36 mm.; length of mandibles, .11 mm.; palpi, .22 mm.; first pair of legs, 1.90 mm.; second pair, .70 mm.; third pair, .50 mm.; fourth pair, .60 mm.

The mandibles are three fourths as long as the palpi and very stout.

The distal segment of the palpi is one half as long as the penultimate; penultimate has a straight bristle on the dorsal surface in front; antipenultimate has a similar but longer and curved bristle on the dorsal surface, antipenultimate is about twice as thick as penultimate and is a little longer; base of palpus is very narrow.

The cephalothorax is joined to the abdomen so that no division can be noticed.

The abdomen is about as broad as thick, there are about six curved bristles on the posterior margin of the abdomen.

The anterior pair of legs are about three and one half times as long as the body; basal segment two thirds as broad as thick; segment two, short, triangular; segment three of leg I a little longer than body; segment four three fifths as long as three; four and five subequal; five has a short, straight bristle on the end away from the median side; it also has several other very short bristles. Legs two, three and four, subequal and possess several rather slender bristles.

The body is pale greenish-yellow; appendages yellowish-brown.

The skin is soft and delicate, the surface rough.

Distribution,--

United States, reported by N. Banks, Sea Cliff, N. Y.

United States, reported by N. Banks, Ft.Lee, N. J.

United States, reported by N. Banks, Chicago, Illinois.
United States, reported by Mrs. A. T. Slosson, Franconia, N.H.
United States, collected by myself, Arcola, Illinois.
United States, collected by myself, Urbana, Illinois.

FAMILY TROMBIDIDAE.

Subfamily Erythraenae.

Actineda agilis. pl.10, fig.1.

1894, N. Banks, New American Acarina. Trans. Amer. Entom. Soc., vol. 21, p. 211.

Average measurements,--length, 1.08 mm.; breadth, .94 mm.; length of palpi, .48 mm.; length of first pair of legs, 1.40 mm.; second pair, 1.40 mm.; third pair, 1.34 mm.; fourth pair, 1.44mm.

The mandibles are about three fifths as long as the palpi and broad at the base; fingers small, about one eighth as long as the rest of the mandibles; each mandible has a long bristle on the upper side about the middle and another similar bristle about one third the distance from this bristle to the end of the mandible.

The palpi are about one third as long as the first pair of legs; basal segment is as broad as long; distal segment about the same length as segment two; segment two has about half a dozen long bristles; the distal segment has many somewhat smaller bristles.

The body is about as broad as long. It has a few long bristles. The body is broadest at the posterior end.

The legs are all about the same length; leg I is a third thicker than leg IV. The anterior pair of legs is half as long again as the body. The legs are clothed with hairs and also possess several long bristles which are about three times as long as

the hairs. The tarsus of leg I is two thirds as long as the tibia.

The mite is a light brown color.

The skin is rather thin; the surface is slightly rough.

Distribution,--

New York, reported by N. Banks, Sea Cliff, L. I.
New Jersey, reported by N. Banks, Ft. Lee.
Illinois, collected by myself, Urbana, Illinois.

Found running over shrubs and other plants. Collected in winter from under boards.

Subfamily Tetranychinae.

Bryobia praetiosa, pl. 11, fig. 1.

1842, C. L. Koch, Myr. Crust. Arach. Deutsche., fasc. 1, fig. 8.

1842, C. L. Koch, (B. gloriosa) Crust. Arach. Deutsche., fasc. 1, fig. 9.

1877, Canestrini and Fanzago. Acar. It., p. 91.

1886, A. Berlese, A. M. Sc. It., fasc. 33, n. 1.

1891, R. Canestrini, Acarofanna It., p. 441.

1905, N. Banks (B. preatensis), Acarina or Mites. Proc. U.S. Nat. Mus., vol. 28, p. 26.

Average measurements,--length, .84 mm.; breadth, .40 mm.; length of palpi, .08 mm.; first pair of legs, .90 mm.; second pair, .44 mm.; third pair, .44 mm.; fourth pair, .46 mm.

The mandibles are small; do not extend to end of palpus.

The palpi are about twice as long as the second segment of leg I; palpi end in a very short, curved claw and a stubby thumb of about the same length as the claw. The thumb has about four long bristles which are about as long as the thumb itself.

The four scale-like projections of the front margin of the cephalothorax extend forwards as far as the end of the palpi; the

free scales of the two outside projections are almost twice as long as the scales of the inside projections; the free scale of the outside projection is about one half as long as the projection itself; those of the inside projections are about one fourth as long as the projection itself; body has several scale-like bristles; body is about as thick as broad and about two thirds as broad as long.

The first pair of legs is longer than the body. The hind pair of legs is about two thirds as long as the body; the second and third pair of legs are subequal. The third segment of leg I is the longest segment; segment four is about two fifths as long as segment three; segment five is twice as long as four. The tarsus is about three fifths as long as segment five. The tarsus has about a dozen bristles, three at the tip being longer than the rest. The tarsus and tibia of the other legs are of almost the same length.

The color is a reddish brown. The body is almost black.

The skin is of moderate thickness, surface of skin is rough, body has small parallel furrows on the dorsum.

Distribution,--

Germany, described by C. L. Koch.
Italy, described by A. Berlese and R. Canestrini.
United States, described by N. Banks.
United States, collected by myself, Urbana, Illinois.

This mite lives upon plants. It is collected from plants and from the bark of trees and under boards. Mr. Hart finds many of them on goose berry leaves.

Subfamily Trombidinae.

Ottonia locustarium. Riley

1877, C. V. Riley, (Trombidium l.). The locust mite. First Rep. U.S. Entom. Com., p. 307.

1894, N. Banks, New American Acarina. Trans. Amer. Entom. Soc., vol. 21, p. 213.

Average measurements,--length, 2.6 mm.; breadth 1.8 mm.; length of palpi, .80 mm.; first pair of legs, 2.20 mm.; second pair, 1.80 mm.; third pair, 1.80 mm.; fourth pair, 2. mm.

The palpi are about one third as long as the first pair of legs. The palpus possesses at the distal end two large hooks or claws, the outer of which is much the stouter and not so sharp as the inner; in addition there are three minor straight claws on the outer ventral margin of the distal segment. The thumb of the palpus is almost as long as the segment to which it is attached. It is almost cylindrical though slightly clavate and is thickly covered with rather short hairs.

The mandibles are two fifths as long as the palpi and possess a piercing organ on the inner side at the end; the piercing organ is about as long as the thumb.

The two eyes are situated on a pedicel at the sides of the cephalothorax.

The abdomen is pyriform in both sexes; the abdomen of the male is very broad in front and narrow behind, being almost as broad as long; in the female the abdomen is not so broad in front as in the male, but is broader behind. The anus is situated on the dorsal side; it is very large and is approximate to the posterior margin of the abdomen. The abdomen is thickly covered

with fine feathery hairs. There is in the male a deep transverse groove on the dorsal surface of the anterior part of the abdomen; the groove extends over one half the way across the abdomen.

The first pair of legs is about as long as the body; the hind pair is of about the same length, while two and three are shorter; segments four and five of leg I join each other at an angle of about 120°; the tibia of leg I is a little longer than the tarsus; the tarsus is broader at the tip than at the base and is thickly clothed with fine, short, plumose hairs. The claws of leg I are very small in comparison with the claws of the other legs. They are about two fifths as long as the other claws.

The color of the mite is a uniform bright, showy red or scarlet.

Distribution,--

United States.--It has a general distribution over the middle west and southern part of the country. I have collected specimens in both Mississippi and Illinois.

Ottonia n.sp.

Average measurements,--length, 4.50 mm.; breadth, 3.10 mm.; length of palpi 1 mm.; first pair of legs, 2.80 mm.; second pair, 1.90 mm.; third pair, 1.90 mm.; fourth pair, 2.40 mm.

The palpi are thick and stout, as long as the first three segments of leg I; segment two broadest, being three fifths as broad as long; segment three broader than long; segment four ending in two stout, curved claws, the outer is the largest and strongest. The thumb is about as long as segment four, and one third as broad as long. It is almost cylindrical in shape and is covered with many feathered hairs.

The cephalothorax is almost completely hidden from above by the projection of the abdomen. The mandibles are two thirds as long as segment two of the palpi and ends in a straight piercing claw, one half as long as the body of the mandibles.

The abdomen is oblong in shape, two thirds as broad as long, slightly broader in front, and ending behind in a blunt oval apex. Legs three and four have their origin together on either side of the abdomen below and about one half the distance from the anterior to the posterior end. The genital opening is about two thirds as broad as long and is situated slightly posterior to the hind pair of legs.

The legs are short. The anterior pair is not quite as long as the body, the second and third pairs are much shorter. The posterior pair of legs extends scarcely beyond the margin of the abdomen.

The coxa of leg one is the broadest segment; it is two thirds as broad as long; segment two is about one half as long as the coxa; three is about three times as long as two; four is two thirds as long as three, five is a little longer than four; six is half again as long as five and the distal segment is about the same length as six and broader at the tip than at the base. Hairs form a whorl at the distal ends of all the segments.

The color of the mite is a uniform red, rather bright.

Distribution,--

United States, collected by myself, Urbana, Illinois.

Found on plants and running around on the ground.

Trombidium n.sp. .

Average measurements,--length, 2 mm.; breadth, 1.80 mm.; length of palpi, .80 mm.; first pair of legs, 2 mm.; second pair, 1.50 mm.; third pair, 1.20 mm.; fourth pair, 1.60 mm.

The palpi are a little longer than the first three segments of leg I. The second and third segments are as broad as long. The fourth segment is rather short and tapers rapidly to form a stout curved claw which is about as long as segment three. The thumb is as long as segment four and is inserted near the base of the segment four on the ventral side; it is clavate, almost in the shape of an Indian club, though rounded at the end, rather thickly clothed with short feather hairs.

The cephalothorax is almost rectangular in shape. Ocular segment is about as long as segment two of leg I, and clavate; mandibles thick; as long as segment two of leg I. Each mandible ends in a piercing organ, which is curved towards the dorsal plane and is slender and tapering.

The abdomen is as broad as long, almost square but broader in front than behind. Hairs of the abdomen thick; clavate in shape with swelling at the end, also denticulate. Genital aperture is twice as long as broad, situated just behind the hind pair of legs. A long transverse groove is situated on the ventral side of the abdomen close to the posterior margin.

The anterior pair of legs is a third longer than the body; the posterior pair extends two thirds its length beyond the margin of the abdomen. The coxa of leg I is twice as long as broad; segment two the shortest, is one third as long as the coxa. The tibia and tarsus are subequal; tarsus broadest at the distal end;

the distal end is turned in to form a sort of a groove, from which the claws extend. The tarsus is thickly covered with very short feather hairs.

The mite is dark red in color.

Distribution,--

United States, collected by myself, Urbana, Illinois.

Found on plants and running on the ground.

Subfamily Rhyncholophirae.

Rhyncopholus paludicola Koch .

1834, C. L. Koch, Deutsche. Crust. Myr. Arach. Heft.16. Taf. 14.

Average measurements,--length, .90 mm.; breadth, .50 mm.; length of palpi, .28 mm.; first pair of legs, 1 mm.; second pair, .66 mm.; third pair, .80 mm.; fourth pair, .90 mm.

The palpi are about as long as segments two and three of leg I; segment four very short, hardly half as long as three and ending in a small, short, curved claw; about one fourth as long as the rest of the segment. Trumb situated close to the end of segment four, twice as long as broad and clothed with a few, stout hairs.

The cephalothorax is of medium size. The mandibles are large, two thirds as long as the palpi; piercing organs one half as long as the rest of the mandibles and tips curved slightly towards the median plane.

The abdomen is three fourths as broad as long, moderately well clothed with stout short hairs; hairs more numerous around the posterior margin of abdomen.

The anterior pair of legs is half as long again as the body, the rest are subequal. The coxa of leg I is broad and thick, seg-

ment two is somewhat broader than usual; three is half again as long as two and much narrower at its proximal end; four is twice as long as two; five is somewhat shorter than four; tibia is about the same length as four; tarsus is two thirds as long as the tibia; it is broader and oval at its tip, rather thickly clothed with hairs. The tarsi of the other legs are shorter and thicker and have on their anterior margin a row of hairs.

The color of the body is black; legs, palpi and mandibles are red.

Distribution,--

Germany, described by C. L. Koch.
Unites States, collected by myself, Urbana, Illinois.

Rhyncopholus n.sp.

Average measurements,--length, .88 mm.; breadth, .50 mm.; length of palpi, .22 mm.; first pair of legs, 1.40 mm.; second pair, .96 mm.; third pair, 1 mm.; fourth pair, 1 mm.

The palpi are almost as long as the first three segments of leg I; segment two three times as long as broad; segment four short and ending in a stout, curved, sharply pointed claw, which is almost as long as the thumb and has a tooth on its concave surface. Thumb clavate, short, with several bristles, with one bristle longer than the rest close to the base.

The cephalothorax is about as long as broad; mandibles two thirds as long as the palpi, and possessing at their end a long, straight piercing organ as long as the body of the mandibles themselves. The mandibles have several rather short curved bristles near the end, one bristle being much longer than the rest and curved towards the median plane.

The abdomen is two thirds as broad as long and has a few short, stiff bristles.

The legs are very long; the anterior pair are almost twice as long as the body; the coxa of leg I is much the thickest segment; segment two about as long as coxa and sub-globular; segment three is twice as long as two; four and five are subequal; tibia somewhat shorter than segment five; tarsus about two thirds as long as tibia, being the thickest segment excepting the coxa; tarsus covered with hairs. The tarsi of the other legs are thicker and shorter and have a row of subequal bristles on the anterior margin.

The color of the mite is a dark red; legs paler than the body.

Distribution,--

United States, collected by myself, Urbana, Illinois.

GLOSSARY.

Abdomen.

The posterior of the two large divisions of the body. It possesses few if any external organs.

Anal plate.

A large chitinous plate forming a part of the exoskeleton and bearing the anal aperture.

Anal plates.

Two chitinous "folding-doors," closing the anus from the exterior. They form a part of the ventral exoskeleton.

Bristles.

Stout hairs.

Camerostome.

The opening in the anterior part of the body into which the mouth parts are inserted.

Cephalothorax.

The anterior of the two large divisions of the body. It is usually pyramidal in shape and much smaller than the abdomen.

Chelate.

Pincer-like, having parts opposed to each other. The mandibles of many genera are chelate, as well as those of all the families, Oribatidae, Gamasidae and Tyroglyphidae.

Clavate.

Having the form of a club, i.e., growing gradually thicker toward the end.

Coxa.

The free segment of the leg, by means of which the leg is attached to the body. The coxa is often small and rather obscure.

=Trochanter. (Pagenstecher Dugès)
=Hanche (Robin, Fumose, Dujardin, Mégnin)
=Exinguinal (Nicolet)
=Racine du membre (Donnadien)

Cusps of the lamellae.

The portions of the lamellae that project in front of its articulation with the cephalothorax.

Cuticula.

The external covering of the mite, synonymous with skin or dermis.

Denticulate.

Having branches resembling teeth. A much more general term than serrate or pectinate.

Dermis.

The external covering of the mite, synonymous with skin and cuticle. The dermis is frequently heavily chitinized.

Dorso-vertex.

The dorsal surface of the cephalothorax behind the rostrum.

Epimera.

Chitinous rod-like projections in the sternal cuticle, which form a rigid skeleton for the support of the legs.

Epistoma.

A thin corneous plate above the mandibles, notably present in Gamasidae.

Femur.

The second segment of the leg counting from the body. It is frequently the largest segment, though not the longest.

= Femoral (Pagenstecher, Dugès, Nicolet)

= Trochanter (Robin, Fumose, Mégnin and Michael in earlier papers, Banks)

= Condyle (Donnadieu)

Flagellum.

A chitinous appendage having its origin near the base of the fingers of the mandibles in the gamasidae, and sometimes spoken of as a "spur."

Genae.

The sides of the rostrum. Each gena in some species ends anteriorly in a small free point.

Genital plate.

A chitinous plate forming a part of the exoskeleton and usually bearing the genital aperture.

Genital plates.

Two chitinous "folding-doors," which when shut close the genital opening through which the exterior genital organs are thrust. They form a part of the ventral exoskeleton.

Genual.

A term used only with reference to mites having five segments to the leg. In these it is the third segment, counting from the body, i.e., middle segment of the leg.

= La jambe (Duges)

= Femur (Robin, Fumose, Mégnin, Michael in earlier papers, Banks)

= First article (Donnadieu)

Hairs.

The term hairs is used to denote such filaments of the cuticula as are relatively small or confined to the body.

Hypostome.

An articulated maxillary lip which partly closes the hood of the Rostrum below.

Interlamellar hairs.

Two large bristles arising from the dorsal surface of the cephalothorax, in front of the pseudo-stigmata.

= Interstigmatic hairs (Nicolet)

Joint.

The articulation between two segments- not the segment itself.

Lamellae.

The lateral outpock-ting of the cuticle of the cephalothorax. Usually blade-like in shape. Found in the Oribatidae.

Lamellar hairs.

Two hairs or bristles usually found on the lamellae near their anterior ends. They are always directed forward.

Mandibles.

The parts of the mouth used for grasping food or prey. Very large and snout-like in Bdellidae; very small in Oribatidae.

Notogaster.

The dorsal surface of the abdomen.

Palpi.

Conspicuous, long, antenniform organs arising from the front

of the cephalothorax. They may have from three to five segments. The distal segment ends usually in one or more prominent bristles. The palpi are organs of touch and perhaps have other important functions.

Pectinate.

Resembling the teeth of a comb. Used in the description of certain branched hairs and also of pseudostigmatic organs.

Pedicel.

An appendage or segment supporting the eye, usually cylindrical, but often clavate in shape.

Penultimate.

Next to the last segment of the palpus, counting from the body.

Progaster.

The anterior part of the notogaster.

Pseudo-stigmata.

Two paired, chitinous, tubular organs situated on the dorsal surface of the cephalothorax close to its base and near the lateral margin. They were once thought to be true stigmata. Found in Oribatidae.

Pseudo-stigmatic organs.

Two paired organs, sometimes setiform, sometimes bulky and of various forms. They always proceed from the anterior part of the pseudo-stigmata and usually are directed at about right angles to the surface of the body.

pteromorphae.

Wing-like expansions of the cuticule on the sides of the abdomen. They sometimes project beyond the margin of the

cephalothorax and abdomen. Found in the Oribata and in Pelops.

Pyriform.

Pear-shaped. A term much used in descriptions of the body or abdomen.

Rostral hairs.

Usually two, sometimes four, paired hairs, on the rostrum near the anterior end.

Rostrum.

Usually a kind of a hood covering the trophi. It is that part of the cephalothorax in front of the dorso-vertex.

Segment.

One of the pieces into which the legs, palpi etc. are divided. That portion between two joints or articulations or beyond a distal articulation.

=Joint (Michael)

Serrate.

Notched along the edge to form teeth like those of a saw. Used in descriptions of hairs and pseudo-stigmatic organ.

Sessile.

Sitting directly on the body without any support.

Setae.

Small bristles, especially when they have unusual forms.

Setiform.

Having the form of a bristle. Long and tapering.

Spatulate.

Shaped like a spatula or resembling a spatula, i.e., flat, with oval margin, broader at the distal end and with a

narrow base.

Spiracle.

A breathing pore usually situated near the mouth or on the sides of the body not far from the posterior coxa, as in the Gamasidae. Not all mites have these spiracles.

Spur.

A projection or appendage which arises near the base of the fingers of the mandibles in the Gamasida, though the term is sometimes used in a general way.

Sternal plate.

A thick chitinous plate situated on the sternum. It forms a part of the exoskeleton.

Tactile hair.

A long bristle on the anterior surface of the distal end of the tibia. More often present on the tibia of leg I.

Tarsus.

The distal segment of a leg.

=Metatarsus (Nicolet)
=3rd. article (Donnadieu)

Tibia.

The second segment of the leg, counting from the distal end of the leg.

= Jambe (Robin, Fumose, Mégnin)
= 4th joint (Michael, in earlier papers.)
= 2nd article (Donnadieu)
= Penultinate (Banks)

Translamella.

A chitinous ridge or it may be only a line, joining the

lamellae at the base of the cusps and bordering the dorsovertex anteriorly. Found in some of the Oribatidae.

ventral plate.

A chitinous shield covering the ventral surface of the abdomen. It is pierced anteriorly by the genital aperture and in the posterior region by the anus.

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LIST OF ABBREVIATIONS.

A.M.S. Jtal. Rep.

Acari, Myriopoda et Scorpiones hucusque in Italia reperta. (A. Berlese)

Acar. Ital.

Acari Italiani. (G. Canestrini)

Amer. Natur.

The American Naturalist.

Ann. Rep. Inj. and Ben. Ins. of Mass.

Annual Report of the Injurious and Beneficial Insects of Massachusetts.

Ann. Sci. Natur. Zool.

Annales des Sciences Naturelles Zoologie.

Arch. Natur.

Archiv fur Naturgeschichte.

Arch. Mus. Hist. Natur.

Archives du Muséum d' Histoire Naturelle.

Arac. di Nias e Sum.

Aracnidi di Nias e di Sumatra. (T. Thorell)

Arac. di Pin.

Aracnidi di Pinang. (T. Thorell)

Arach. Sib. und Nov. Sem.

Arachniden aus Sibirien und Novaja Semlja. (L. Koch)

Atti d. R.J.nst. Ven. di Sci.,Let. ed Ar.

Atti del Reale Instituto Veneto di Scienze, Lettere ed Arti.

Baust. Acarof. Ung.

Bausteine zu Einer Acarofauna Ungarns (L. Karpelles)

Bib. Zool.

Bibliotheca Zoologica.

Ber. Senck. Naturf. Ges.

Bericht der Seucken. Naturf'n Gesell.

Bull. Soc. Entom. France.

Bulletin de la Societe Entomologique de France.

Bull. Soc. Entom. Ital.

Bullettino della Societa Entomologica Italiana.

Bull. U. S. Dep. Agr.

Bulletin of U. S. Department of Agriculture. Division of Entomology.

Econ. Ent. Apt.

Aconomic Entomology- Aptera. (A. Murray)

Entom. N.

Entomological News.

Econ. Proc. Roy. Dub. Soc.

Economic Proceedings of the Royal Dublin Society.

Can. Entom.

Canadian Entomologist.

Das Tier.

Das Tierreich.

Deut. Entom. Ztschr.

Deutsche Entomologische Zeitschrift.

Deutsch. Crust. Myr. Arach.

Deutschlands Crustaceen, Myriapoden und Arachniden. (C. L. Koch)

G. Ac. Agr.

Gli Acari Agrarii. (A. Berlese)

Ill. Mus. Nat. Hist.
Illinois Museum of Natural History. (S. A. Forbes)

Int. Ag. Acari Ital.
Intorno Agli Acari Italiani.

Jag.,Swed. Zool. Exp. Egypt.
Jagerskiold, Swedish Zoological Expedition to Egypt.

Jour. Acad. Natur. Sci. Phil.
Journal of the Academy of Natural Sciences of Philadelphia.

Jour. Anat. e Phy.
Journal de La Anatomie et de La Physiologie.

Jour. N.Y. Entom. Soc.
Journal of the New York Entomological Society.

Jour. Roy. Micro. Soc.
Journal of the Royal Microscopical Society.

Krat. Mensch. und Th.
Die Kratzmilben der Menschen und Thiere. (M.H.F.Fwistenberg)

Math. Natur. Ber. Ugr.
Mathematische und Naturwissenschaftliche Berichte aus Ugarn.

Mem. Nat. Acad. Sci.
Memoirs of the National Academy of Sciences.

Micr. and Rev.
The Microscope and its Revelations. (Carpenter)

Mon. Ark. Acar.
Monographie der Arktischen Acariden. (I. Tragardh)

N. Acar. Ital.
Nuovi Aracnidi Italiani. (G. Canestrini)

N. Sp. Gen. Derm.
Nuove Specie del Genere Dermaleichus (G. Canestrini)

Proc. Cal. Acad. Sci.

Proceedings of the California Academy of Sciences.

Proc. Entom. Soc. Wash.

Proceedings of the Entomological Society of Washington.

Proc. U. S. Nat. Mus.

Proceedings of the United States National Museum.

Proc. Zool. Soc. Lond.

Proceedings of the Zoological Society of London.

Prosp. Acarf. Ital.

Prospetto dell' Acarofauna Italiana.

Rep. U. S. Entom. Com.

Reports of the United States Entomological Commission.

Tij. Nederl. Dierk. Ver.

Tijdschrift der Nederlandsche Dierkundige Vereeniging.
(M. Weber)

Trans. Amer. Entom. Soc.

Transactions of the American Entomological Society.

Verk. Zool.- Bot. Ges. Wein.

Verhandlungen Zool.- Botan. Gesellschaft in Wein.

Zeits. Wissen. Zool.

Zeitschrift für Wissenschaftliche Zoologie.

Zool. Anz.

Zoologischer Anzeiger.

Zool. Centr.

Zoologisches Centralblatt.

Zool. ergeb. Russ. exp. nach. Spitz. Ar. et Ori.

Zoologische ergebnisse der Russischen expedition nach
Spitzbergen; Araneae et Oribatidae. (V. Kulczynsk)

EXPLANATION OF PLATES.

Plate I, Fig. 1. Holostaspis n.sp. , p. 33.

Plate II, Fig. 1. Gamasid n.sp.(?) .

Plate III, Oribata (n.sp.) Fig. 1, palpus; Fig. 2, pseudostigmata and pectinate bristle; Fig. 3, adult. p.39.

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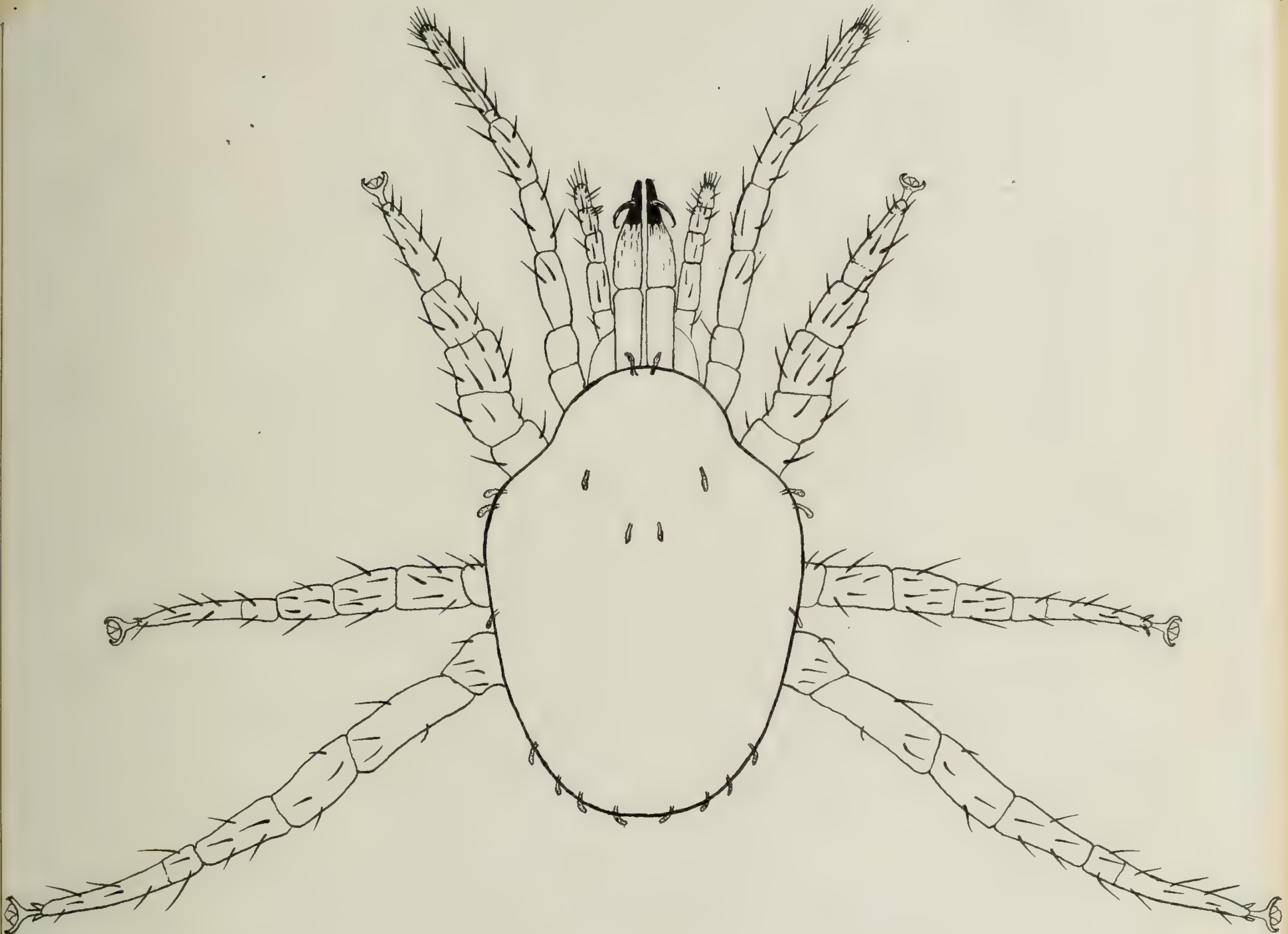


Fig. 1.

PLATE II.

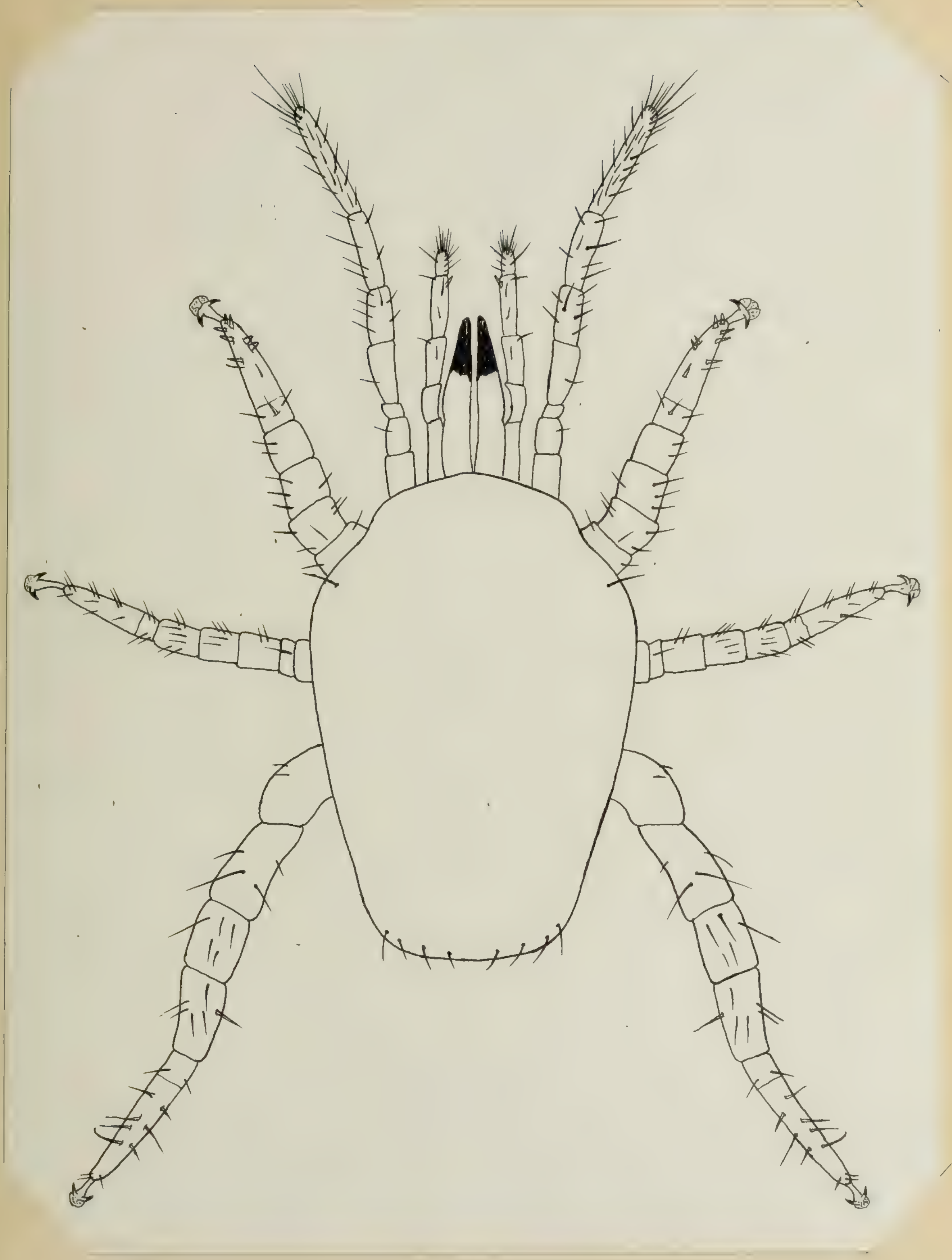


Fig. 1

PLATE III.

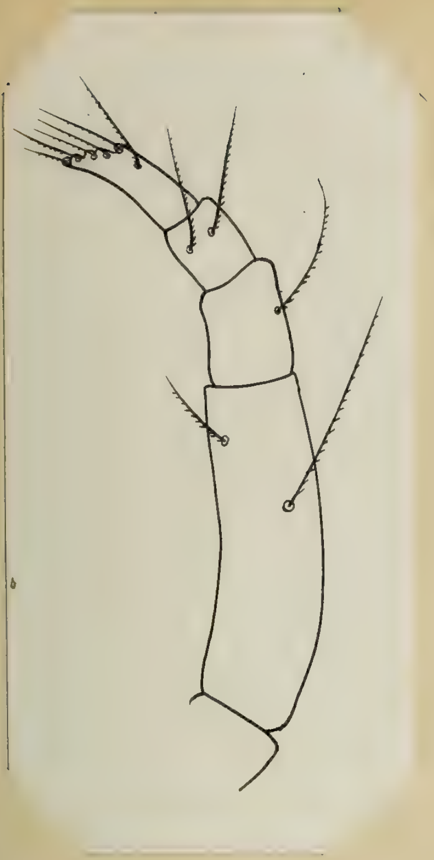



Fig. 1.

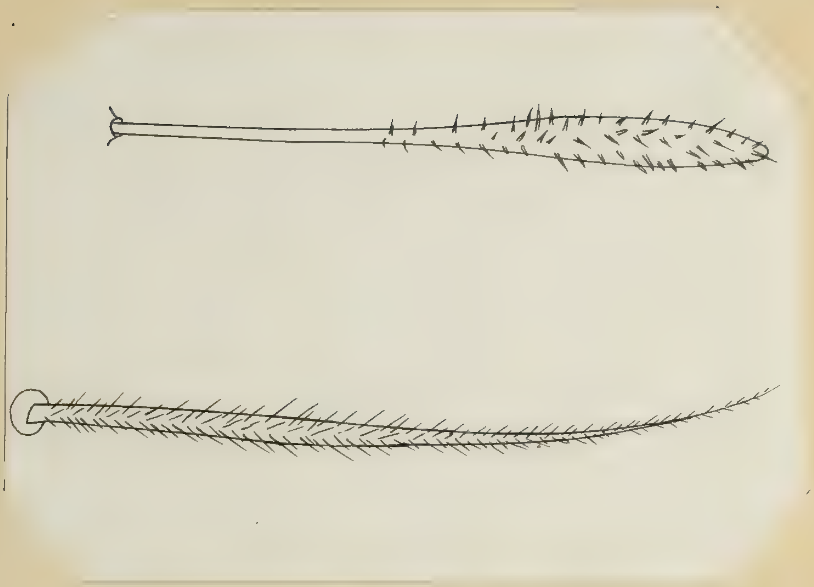


Fig. 2.

Fig. 3.

PLATE IV

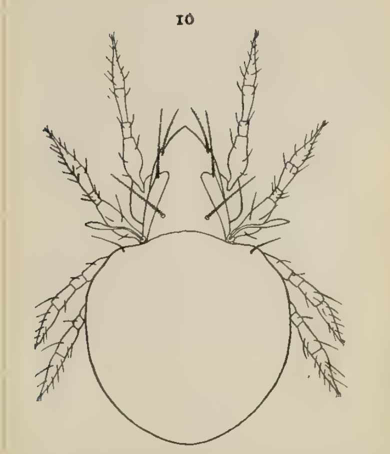


Fig. 1.

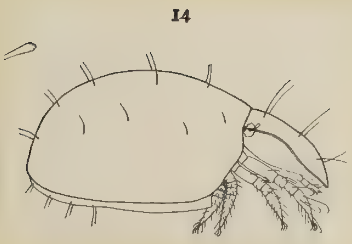


Fig. 2.

PLATE V.

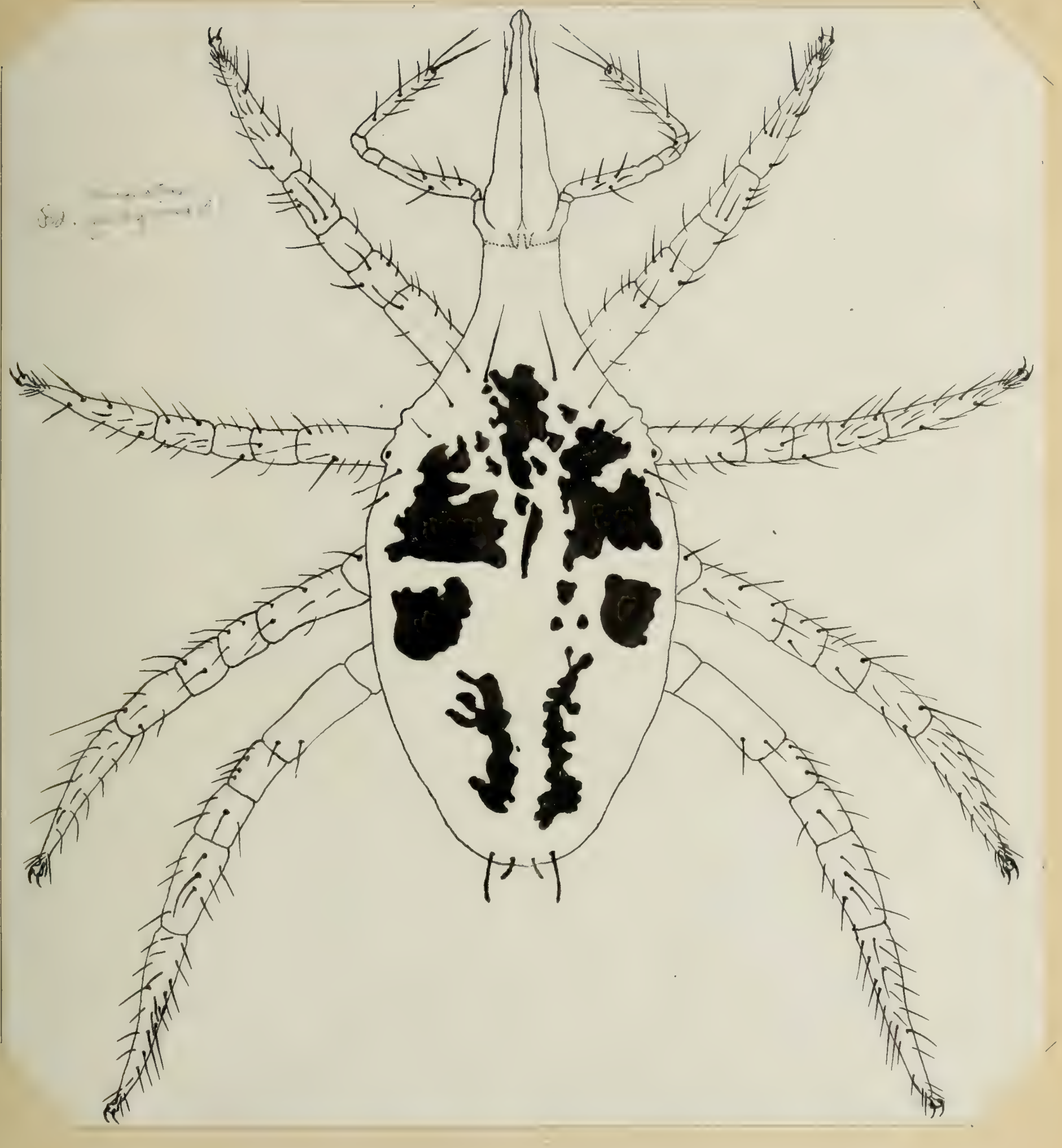


Fig. 1.

PLATE VI

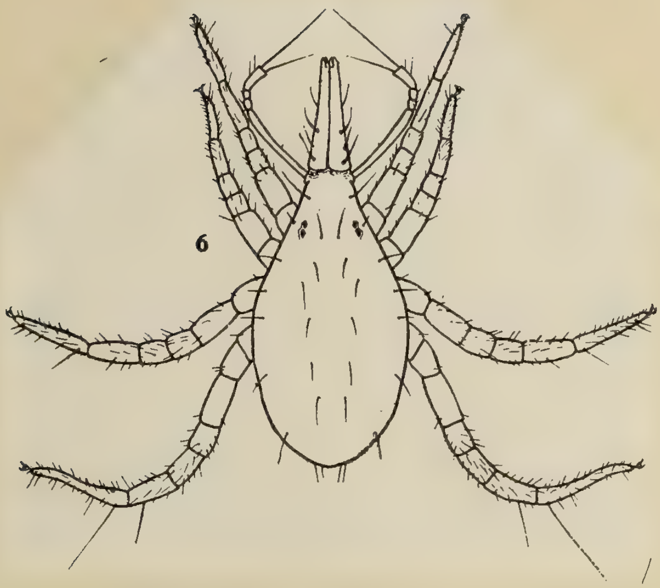


Fig. 1.

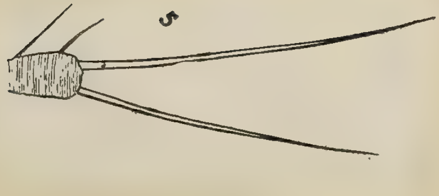


Fig. 2.

Fig. 1.

Fig. 2.

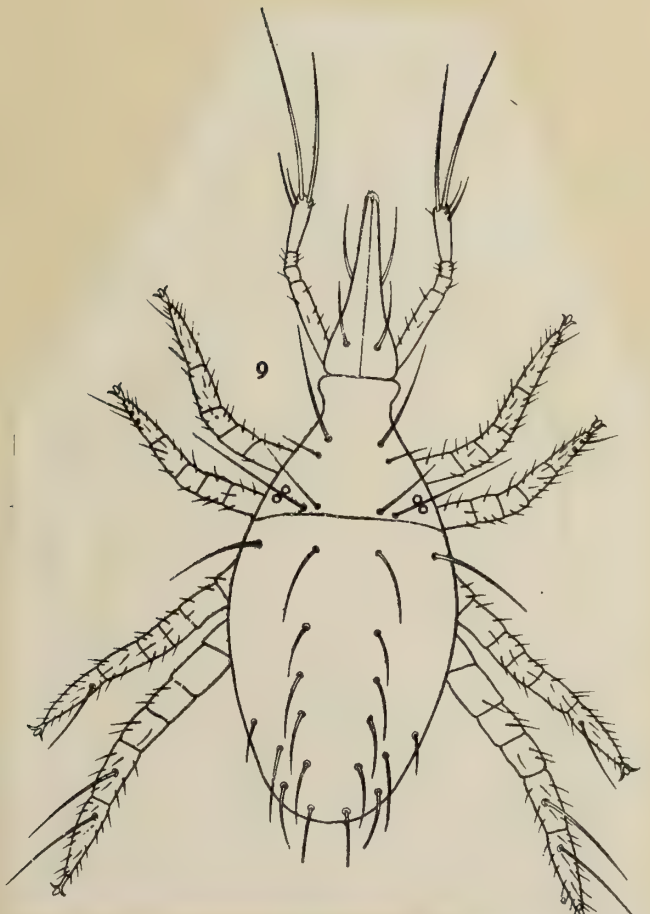


Fig. 3.

PLATE VIII.

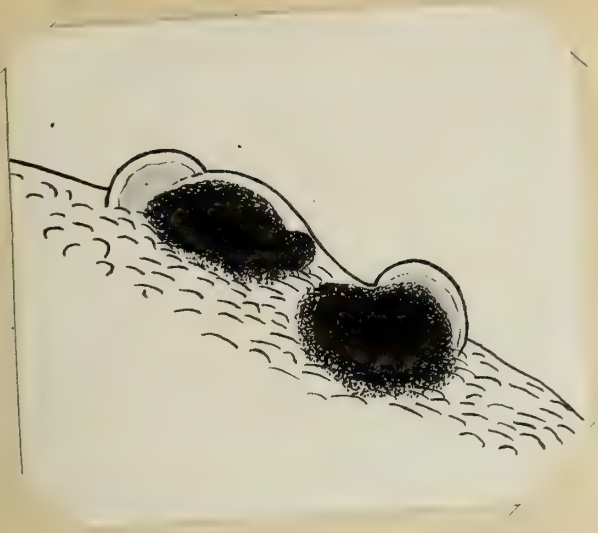


Fig. 1.

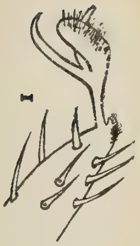


Fig. 2.

Fig. 3.

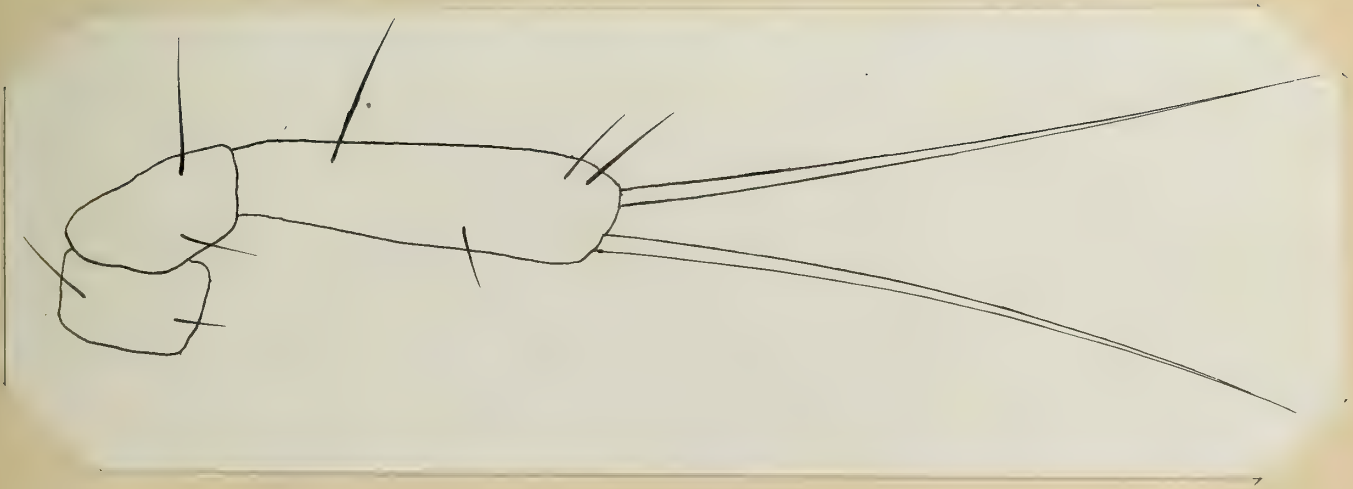


Fig. 4.

PLATE IX.

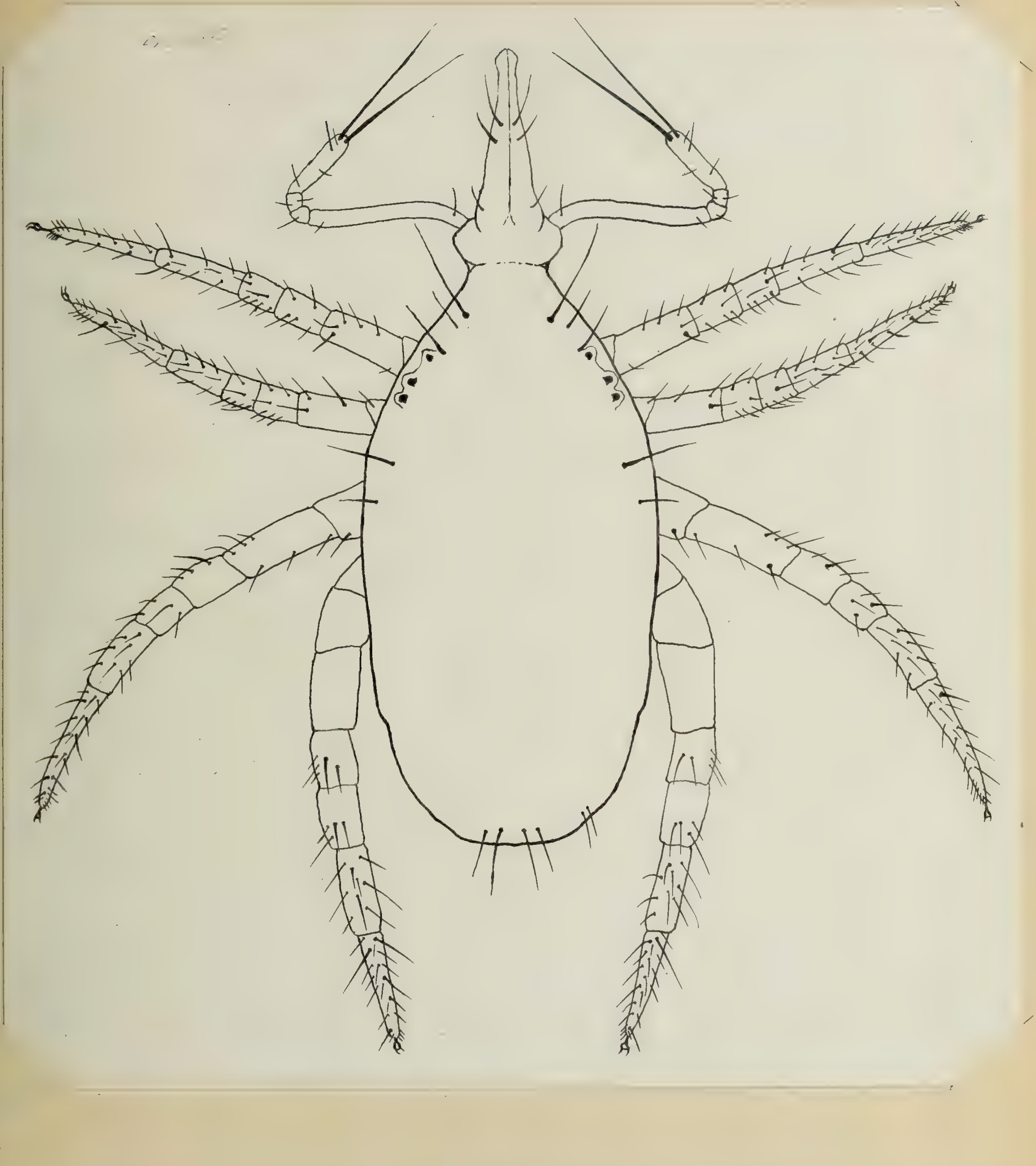


Fig. 1.

PLATE X.

Fig. 1.

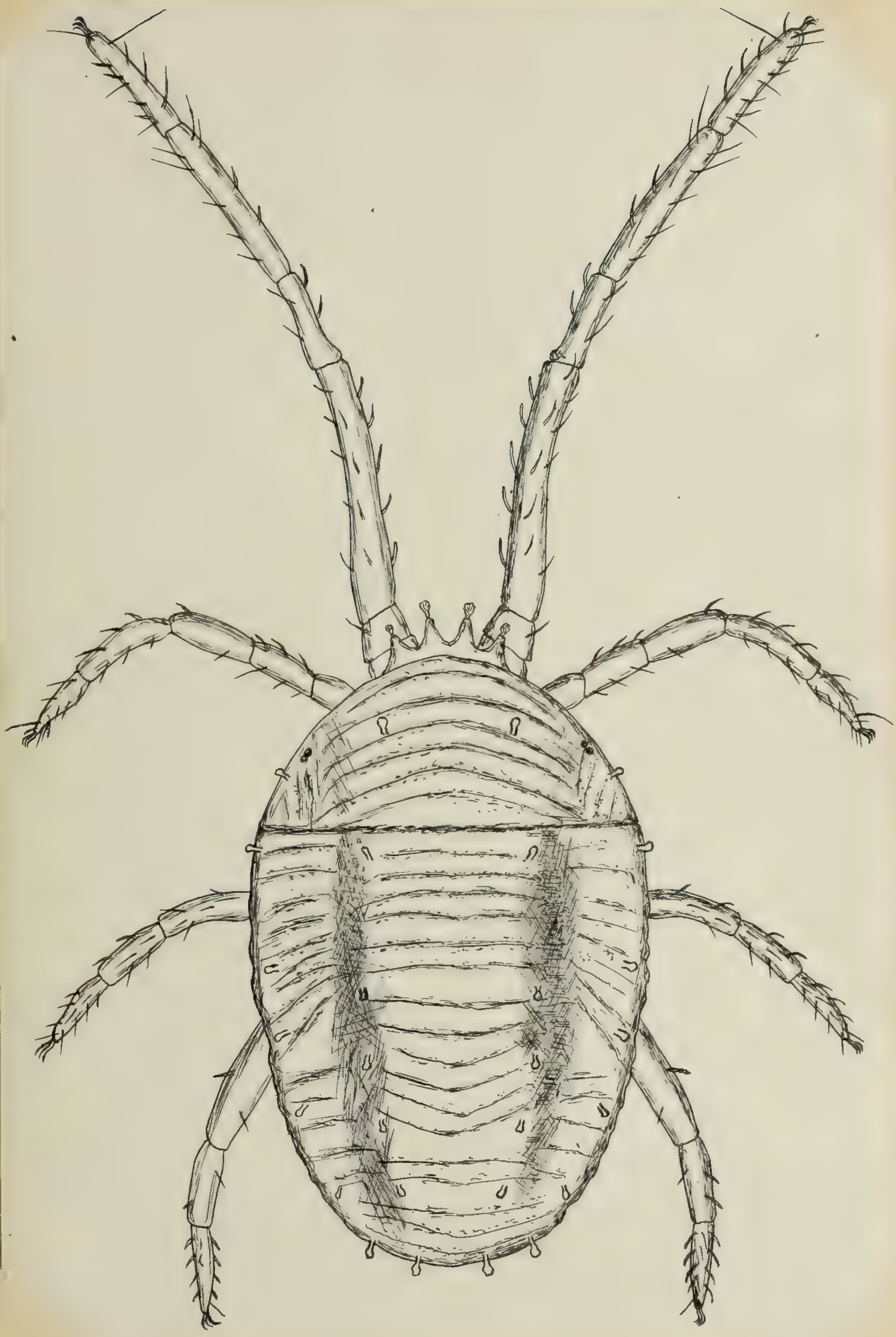
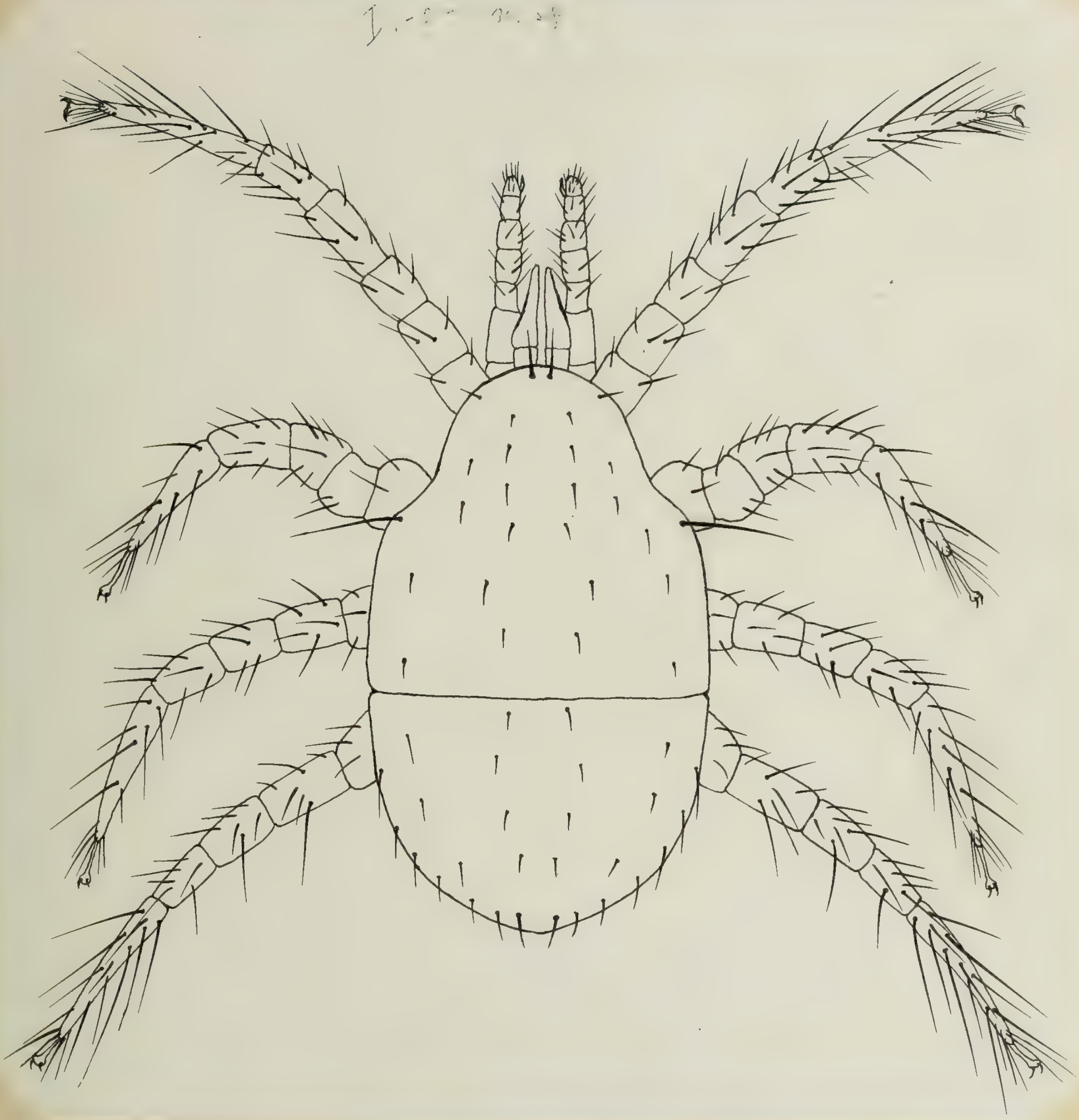


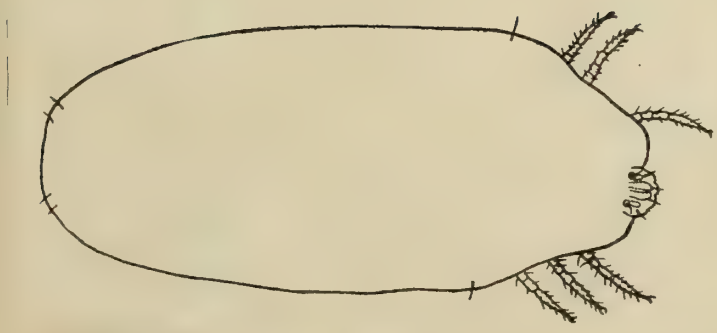
Fig. 1.



Type of Gamasidae. (I-2-)

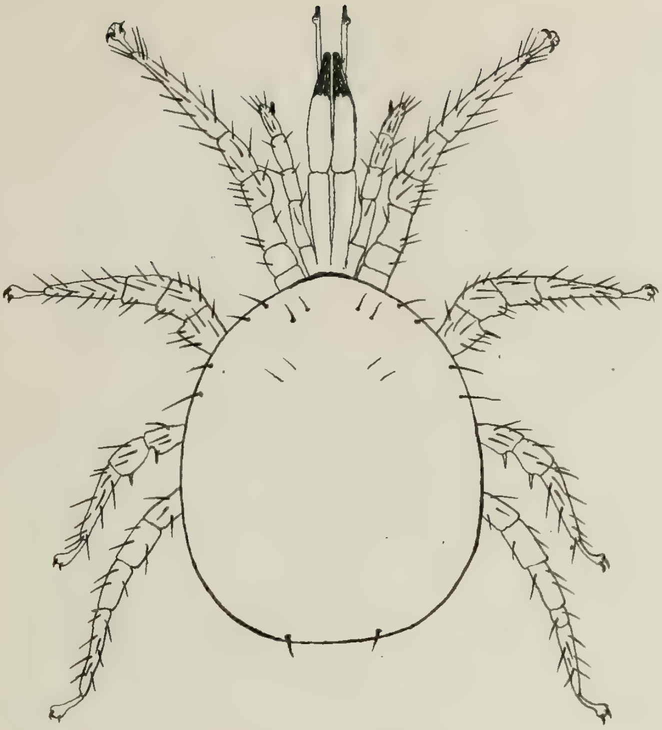
PLATE XIII

Egg of Tetranychinae.

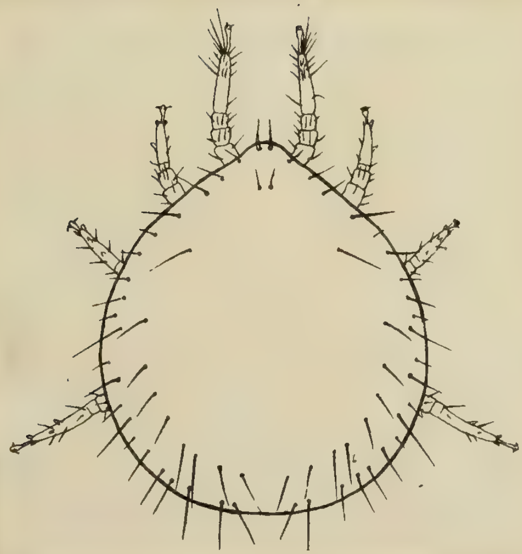


Larva of Ottonia locustarium.

PLATE XIV



A Gamasid. Fig. 1



A Uropod. Fig. 2

PLATE XV.

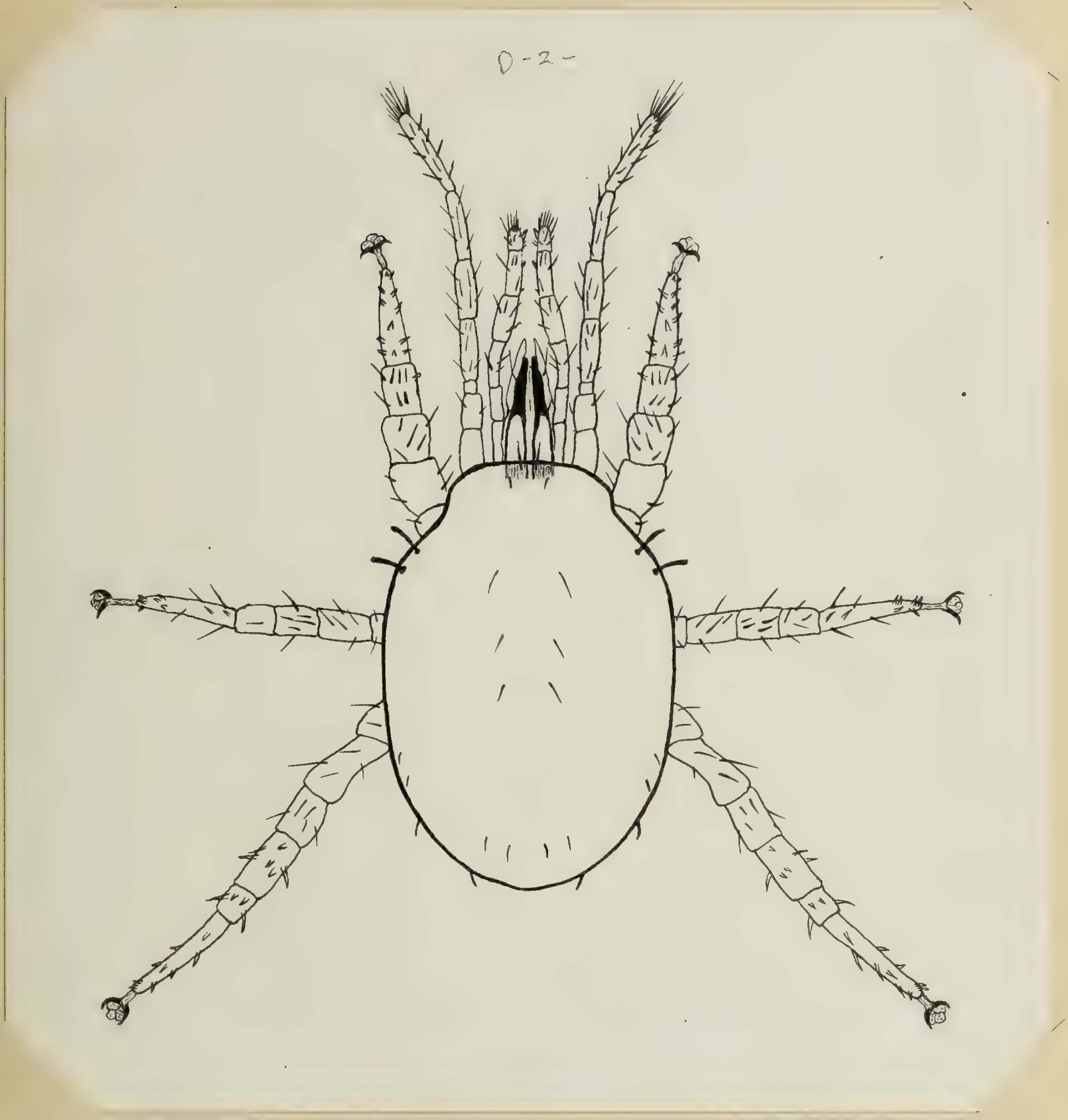


Fig. 1, D-2

PLATE XVI.

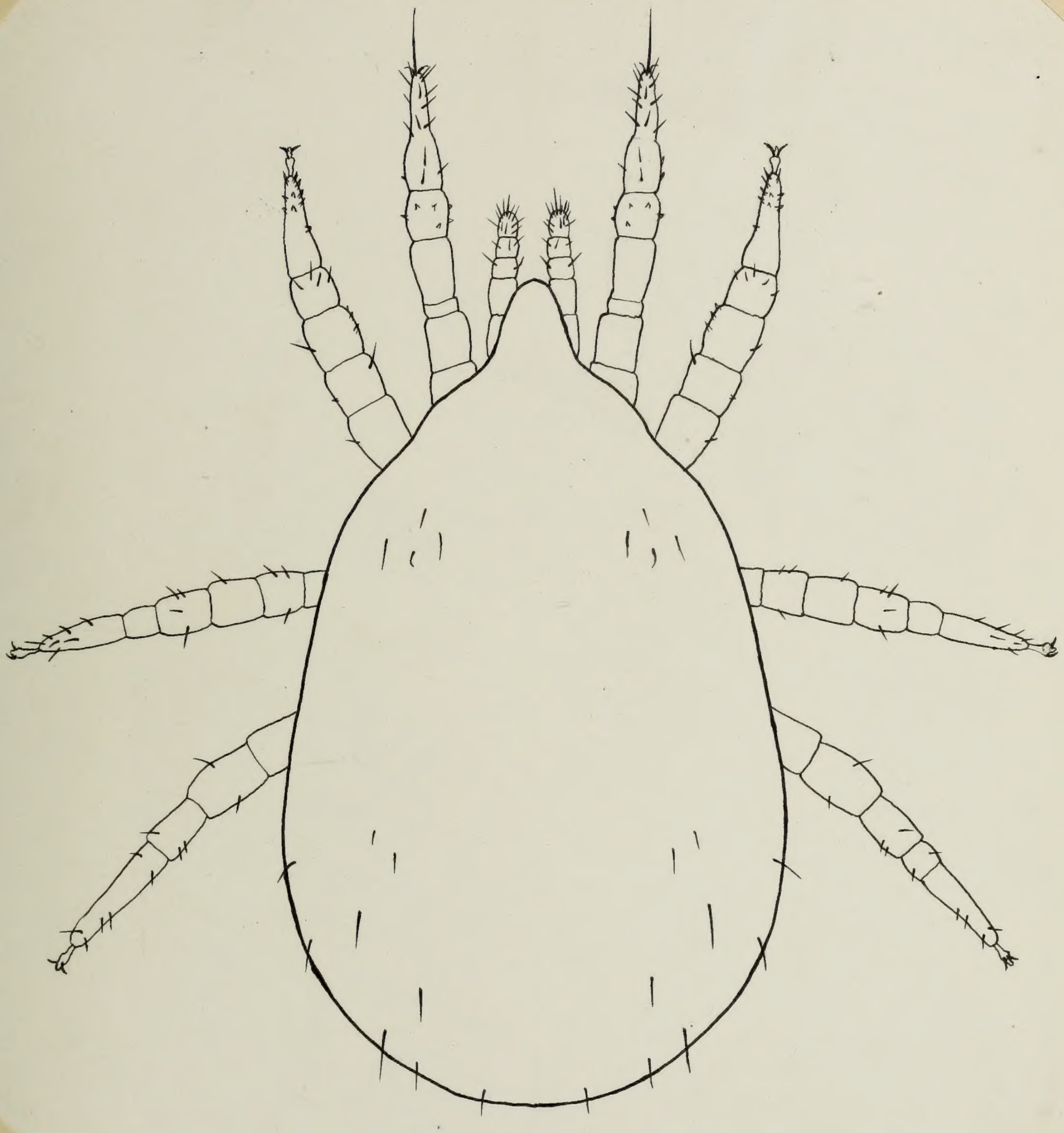


Fig. 1. g.-3-